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The Status of Steller's Albatross

OLIVER L. AUSTIN, JR.[1]

THE SHORT-TAILED ALBATROSS or Steller's Albatross, *Diomedea albatrus,* the largest and handsomest of the three North Pacific albatrosses, was abundant at the turn of the present century, but has become so rare during the past two decades that it may soon be extinct, if it is not already so. Because it seems unlikely that we will ever learn more about it at first hand, this paper attempts to clarify our knowledge of the species by examining and evaluating all the known written record. For a bird that so recently was relatively common, accurate data are remarkably scarce in literature. Much of the most pertinent and illuminating information about it is written in Japanese. As these writings have never before been translated or summarized, the data they contain have heretofore been unavailable to western scientists.

Steller's Albatross was discovered by the famous German naturalist whose name it bears, during his travels with Commander Bering in Kamchatka and the Bering Sea in the 1740's. It was described and named in 1780 by P. S. Pallas, in his *Spicilegia Zoologica,* from a specimen taken off Kamchatka. Since then ornithologists, other than the Japanese, have been able to do little more than describe the physical features of the scanty specimen material available—most of it taken at sea during the non-breeding season—and to delineate its former habitat from the data on the labels of these specimens, and from bones found in prehistoric shell-heaps and kitchen middens in Oregon and California. During the non-breeding season the species apparently ranged widely over the North Pacific, from the China coast northward to Kamchatka and the Bering Sea (northernmost record, Norton Sound, Alaska), and down the Pacific coast of North America to lower California.

We now know, as will be shown in detail later, that the breeding range of Steller's Albatross was limited to isolated oceanic islets south of Japan. It bred, definitely, in the southern Izus, northern Bonins, and southern Ryukyus, and perhaps, though confirmatory specimen evidence is lacking, in the Pescadores and Daito Islands as well. All western accounts to date, however, list the species as breeding only in the Bonins and, erroneously, on Wake Island.

The inclusion of Wake in the breeding range of the species is apparently based on the writings of Titian R. Peale, who visited Wake in 1841 as naturalist on the United States exploring expeditions which cruised Pacific and Antarctic waters from 1838 to 1842 under Lt. Charles L. Wilkes. Peale quarreled with Wilkes shortly after the expedition's return and the latter accordingly refused to allow him to publish his findings. His notes were eventually incorporated by John Cassin in his report on the expedition's specimen material published 15 years later, in 1858. Peale's and Cassin's identification of the birds on Wake has been accepted without question and has been quoted widely ever since. On careful re-examination of the evidence, however, it becomes quite apparent that Peale's notes on the Wake Island albatrosses refer not to *D. albatrus,* but to the Laysan Albatross, *D. immutabilis,* which was not recognized as a distinct species until 1893, half a century later.

[1] Head, Wildlife Branch, Natural Resources Section, General Headquarters, Supreme Commander for the Allied Powers. Published with permission of Lt. Col. H. G. Schenck, Chief, Natural Resources Section. Abstract read at Pacific Science Congress, Auckland, N. Z., February 21, 1949. Manuscript received March 23, 1949.

No specimens are available today to verify the identification of the albatrosses Peale found nesting on Wake. If Peale collected any specimens there Cassin does not mention the fact, and no other naturalist visited the colony before it was wiped out by feather hunters later in the 19th century. Peale mentions finding both light and dark colored albatrosses on Wake, but he believed the dark birds (ostensibly the Black-footed Albatross, *D. nigripes*) to be the immature form of the light colored bird, which Cassin lists as *D. brachyura* (a synonym of *D. albatrus*), and which he states was the only albatross species encountered by the expedition in the North Pacific. Most significant, however, are Peale's measurements of the albatross eggs he found on Wake, which Cassin gives as 4.2 x 2.6 inches. These are smaller than those of typical *D. albatrus* from the Bonins and Torishima, but well within the range of those of *D. immutabilis* from Laysan.

Had Steller's Albatross ever bred on Wake, it is difficult to account for its absence on the Marcus Island rookery, which was visited and reported on by both American and Japanese naturalists before it, too, succumbed to the attentions of the feather hunters in the early 20th century. Marcus Island lies almost midway between Wake and the nearest verified breeding grounds of *D. albatrus* in the Bonins, and is the only spot of land in that 1,700-mile expanse of sea. Both Bryan (1903: 77–116) and Namiye (1905: 219) report *D. immutabilis* and *D. nigripes* as having bred on Marcus, but no record exists of *D. albatrus* ever having occurred there. Hence, it is unlikely that Steller's Albatross ever bred eastward of the Bonin–Izu Island chain.

The first unquestionable record of the nesting of Steller's Albatross is the five eggs in the Pryer Collection, which Seebohm (1890: 105) says "are labelled as having come from the Bonin Islands." These eggs apparently were collected by P. A. Holst, who probably collected at the same time the 12 eggs from the Bonins that are in the British Museum. Holst himself never wrote a word of his experiences in the Bonins, and no one knows on which of the islands he collected the eggs. Bent (1922: 7) gives the average measurements of 43 eggs in various museums in America and Europe, but he gives egg collection dates only for the Bonins and adds, "I can not find any description of the downy young and doubt if they have ever been collected."

Nothing, other than Peale's brief and misapplied account, has ever been written in western literature of the species' breeding habits. No occidental ornithologist other than Holst has ever, to our knowledge, been on its breeding grounds. At least, if anyone has, he has left no written record of his experiences. La Touche (1895: 327) encountered Steller's Albatrosses in the Pescadores and says that on February 10, 1894, "they absolutely swarmed" about his ship when it was anchored off Fisher Island.[2] But he found no sign of the bird when he went ashore there, and in writing of the species 40 years later (1935: 429), he lists it as breeding only in the Bonins.

The *Hand-List of Japanese Birds* for 1932 and 1942 add the following breeding localities, but without further elaboration or substantiation: Torishima in the southern Izus, Kitanoshima and Nishinoshima in the Bonins, Kobisho and Agincourt in the southern Ryukyus, and the Pescadores. Referring back to the original Japanese papers for the evidence on which these statements are based, we find some of them to be vague and inadequately documented. These papers contain, nevertheless, information which adds greatly to our knowledge of the species, as the following sections show.

In Japanese, incidentally, albatrosses in general are known as "aho-dori" or "baka-dori," both of which mean "fool-bird." These appellations, which date back to medieval times and have become integral, autochthonous parts of the language, were undoubtedly engendered by the birds' manifest stupidity and tameness, par-

[2] Byo-o-to, 23° 36′ x 119° 30′, one of the larger islands in the center of the group.

ticularly on their breeding grounds. Modern usage by contemporary Japanese ornithologists restricts the common name "aho-dori" to Steller's Albatross. The Laysan Albatross is now referred to specifically as the "Ko-aho-dori" (small albatross), while for the Black-footed Albatross, its English name has been borrowed and translated as "Kuro-ashi-aho-dori."

TORISHIMA

The largest and most famous colony of Steller's Albatross ever known flourished on Torishima (literally "Bird Island"),[3] the southernmost of the Seven Islands of Izu, an isolated islet about 300 miles due south of Tokyo. Torishima is actually the conical top of a volcano, almost circular, and about 1½ miles in diameter, projecting about 1,150 feet above the sea surface. Its shore line is rimmed with cliffs that make landing difficult except during the calmest weather. It was uninhabited and was visited only by the few fishermen and whalers who happened to pass that way, until the opening of the feather trade in the 1880's made living there economically desirable.

The island has been known to the Japanese since about 1700. The coastal whalers and fishermen who passed by it in those early days apparently bothered the swarms of birds very little. However, old Tokugawa legends say that the whalers occasionally brought albatrosses into Edo City (now Tokyo), where the meat was sold under the name of "Okino-tsuru" (offshore crane) or "Nadano-tsuru" (rough-sea crane). The first settlement of the island was made by about 50 Japanese who arrived there in November, 1887, to collect feathers. They killed albatrosses steadily each year throughout the breeding season from October to May, and when not so engaged, eked out their living with a little desultory farming and fishing.

The first authentic account of the island was written by a Japanese named Toru Hattori, about whom biographical details are lacking. Although not primarily an ornithologist (this is his only known paper), he was obviously an educated man and something of a scientist. Hattori made a 2-year survey trip, apparently for the Japanese Government, through the Izu and Bonin Islands, during which he spent more than 100 days from April to July, 1889, on Torishima. Soon after his return to Tokyo he wrote and published in the *Zoological Magazine* (Hattori, 1889) what still remains the best available description of the island's bird colony. His account is worth quoting in some detail, for it furnishes many hitherto unknown facts about Steller's Albatross:

> Though the island lacks drinking water, it has hot springs and good earth, but no trees. Instead, the whole island is covered everywhere by thick reeds, or "Mukasa" in the local Hachijo dialect, which provide good resorts for the albatrosses. There are three or four large concentrations of the birds, which are called "Torihara" or "Torippara" [literally "bird field"]. The largest one, which is on top of the island, covers almost 25 acres and is covered with innumerable birds. The people call it the "Umi gachobara" [sea goose field]. The other concentrations are smaller, covering from 7 to 12 acres each. At a distance the albatrosses on them might be mistaken for fallen snow. When they fly up in the sky, they resemble a swarm of mosquitoes and they float in the air like white breaking waves, truly a sight more than wonderful!
>
> . . . The two species of albatrosses here, which both belong to the genus *Diomedea,* are known locally as the "Shirabu" [white pattern] and "Kurobu" [black pattern] from the color of their plumage, but they are often confused. The one commonest on our island is the "Shirabu," which . . . is very rich in fat, each bird yielding over a pint. They are especially fatty from September to November, but lose much of it during the period of feeding the young. The feathers smell badly, but not as badly as the meat . . . .
>
> We experienced here some most astonishing and intolerable things, particularly the peculiar smell which enveloped us continually, the birds' cries which continued without ceasing throughout the night, and a kind of tick which attacked us freely. We became accustomed to the smell in a few days, but the never-ceasing night cries

[3] Lat. 30° 29′ N, Long. 140° 19′ E; also called Ponafidin or St. Peters Island.

broke our sleep and assaulted our ears from all sides, even above the pounding of the sea. The ticks roamed everywhere on the island. . . . When we arose from our beds in the morning, we found them on the floor filled with our blood from their night feeding. They particularly attacked our feet, causing them to swell greatly. They also appeared to attack the bird's feet to suck blood. The birds also have a kind of feather louse and a few other external parasites, one of which is a small beetle which has a very offensive smell and also attacks man.

. . . The albatrosses fly in large flocks 10 or 12 miles from the island, but are more numerous within 5 to 8 miles. They are most plentiful on the sea on fine, calm days. Few are seen during rough weather . . .

When suddenly alarmed, a bird which has come back from the sea vomits an evil smelling substance, which on examination proved to be a kind of shrimp. None of them was complete enough, however, for myself or even the fishermen to determine the species. The next food in abundance was a squid (*Ommastrephes sloani pacificus*), most familiar to us in Honshu. At times half digested miscellaneous fish meat and bones were found, and occasionally quite a large fish is vomited. The fact that all these foods are plentiful in the vicinity probably makes the island particularly attractive to the albatrosses.

They begin to appear on the island in September and by the latter part of October they cover the whole island. From where they come, where they copulate, or which is the male and which the female are hard to tell. The black colored young birds do not come back after they have left the island, but the smaller individuals with the black spotted plumage which appear the following autumn may be one-year-old birds.

In September and October they build concave nests of earth, about two feet in diameter. The site selected is an open place, with low, soft grasses, the reed fields being avoided. Each bird lays only a single egg, about 6½ inches long and 2¾ inches thick. The shell is white and thin, very fragile and very smelly. The contents are less albuminous than a hen's egg, and not as good eating. The incubation is done very faithfully, the birds not taking any food during it. At the approach of men, they only clack their bills with anger but never leave the nest. We could not make them quit their nests even by lighting a fire in the nearby grasses and they remained even though their plumage took fire.

The hatching period begins in January. When born the chicks are covered with pale black down, thinner on the head, and with black feet and bills. The parents now become very busy, carrying food in their crops from the nearby waters. They feed the young, bill to bill, with a yellow, bad smelling liquid. During this vomiting operation the parent appears to be in great agony, but the structure of their bills is well adapted for this method of feeding. Whether this liquid is a nourishing substance produced in the bird's crop, or nothing but rotten fish juice is not clear. The young birds vomit this yellow substance when frightened.

The death rate of the chicks is high, the main causes being starvation after losing their parents, death from parasitic insects, and, worst of all, the attacks of crows, which are very abundant on the island. Two or three crows will attack a chick, picking at its hip until they kill it, and then devour it. Almost one-third of the chicks perish from these causes. Not only the chicks but also well-fledged young birds and even adults often die, being unable to fly out of bushy places where they alight. We found the carcasses and bones of many such birds scattered over the island.

By early June young birds are grown almost to adult size. The head is the last to acquire true feathers. They are fed by the adults until the parents leave the island in the middle or end of June. Then the young birds begin to leave the island, taking advantage of favorable winds, most often during the night when the sea is calm. Early mornings during this period the black young birds cover nearly the whole sea surface near the island. They remain and feed freely near the shore for the first week or so. But after the first windy night with rough seas, you will not find a single bird remaining the next morning. Thus the whole island is entirely cleaned out of albatrosses by mid-July.

The so-called "doyonami" [mid-summer big waves], which visit the Pacific coast of Honshu at this season, are often accompanied by many young black albatrosses, which are frequently mistaken for the other species, the "Kurobu." This latter bird is smaller than the foregoing. It is more gentle by nature and never mixes with the "Shirabu" colony but nests and rears its young near the shore. Its breeding season is later than the "Shirabu". . . .

The feathers are sold as a substitute for cotton, or for ornamental use. Its fat is used for food and manufacturing, and the dried meat makes fertilizer. Forty men and women came here and began to slaughter albatrosses last year. To catch the birds, they approach them in parties of four to prevent the bird from flying up. They can only run with outstretched wings until they come to a slope or get a favorable gust of wind; so they are chased upward from below. Thus the birds in the reeds have to be surrounded, but the incubating birds are very easily approached. They are killed by striking them on the head with a club, and it is not difficult for a man to kill between 100 and 200 birds daily.

When I left the island in July, the decrease of birds was not yet perceptible. Likewise, they were as tame as they were early in the season. After staying on this unique southern island with the albatrosses as my friends, I have felt an intimate feeling of attachment for them, with which feeling I have written this paper.

The Japanese settlement on Torishima, which gained its living almost entirely by killing albatrosses, increased steadily as the feather trade continued to grow through the 1890's, and by 1900 it boasted a population of at least 300. The immensity of their scale of operations is suggested by the hand-railway they built to carry feathers from the top of the island to the shore, where a cableway to the roadstead in Chitose Bay facilitated loading the spoils. Yamashina (1942: 244) estimates that they had slaughtered at least 5,000,000 albatrosses by August, 1903, when the island's volcano erupted and stopped the feather gathering temporarily by killing all the Japanese inhabitants. As the eruption occurred during the non-breeding season (of the albatrosses) its only effect on the birds was to destroy part of the former nesting territory.

Very little information is available about conditions on Torishima between 1903 and 1930. The Japanese resettled the island a few years after the eruption, and began their feather harvesting again, but nothing further was written about the island and its birds until Viscount Yamashina landed there on February 15, 1930. He was able to spend only a few hours on the island, but after returning to Tokyo he wrote (1931: 5–10):

Torishima is no longer as it used to be, although it is probably still the most important breeding place of this bird. . . .

When we climbed to the top of the crater wall we saw a *Haliaetus pelagicus* fly away. The flat bottom of the huge crater, 350 yards wide and 900 yards long, was filled with damp spots or pools caused by the rain. Here we found about 20 Steller's Albatrosses, which, according to the villagers accompanying us, are unable to fly out from the bottom of the crater and remain there to become the victims, one by one, of the eagle we saw.

The top of the crater wall was pebbly. At the east end of it we found a colony of about 400 *Diomedea albatrus*. No unhatched eggs remained but we found about 30 chicks, grown to the size of a cat. . . . Walking further along the edge of the crater we found a sandy plain extending from the east end, one corner of which was occupied by about 1,000 Steller's Albatrosses. This constitutes the main breeding colony on the island. Even taking into consideration the eggs stolen by the natives, we get some idea of the low rate of reproduction of this species from the fact there were less than 100 chicks among the birds.

The south side of the crater wall was covered with reeds, but in bare spots here and there we found smaller colonies from 20 to 100 birds each. In one of these I saw with my own eyes the terrific slaughter which I could hardly bear to witness. Only the word "slaughter" can express the sight. This called to my mind the paragraph in Hornaday's "The Tragedy of the Laysan Albatross" (p. 242). "Schlemmer, the slaughterer, bought a cheap vessel, hired 23 phlegmatic and cold-blooded Japanese laborers and organized a raid on Laysan." I hope to prevent any further such unpleasant occurrences in Japan.

Yamashina was as good as his word, and, largely as a result of his efforts, Torishima was declared a "Kinryoku" (no hunting area) in 1933 for a period of 10 years. We will never know whether this designation would have saved the colony, for the inhabitants of the island, in anticipation of the impending legislation, wiped out the birds before official word of

it could reach them. Unable to return in person, Yamashina had sent his assistant, Mr. Nobuo Yamada, there in 1932 and 1933 to observe conditions for him. Yamashina writes of those last days as follows (1942: 244):

On this remote island the policy of protecting the albatross was not strong enough to prevent the collecting of their feathers, which continued undiminished. When I visited the island in February 1929 there were only about 2,000 albatrosses there. When Yamada went there in April 1932, he observed only a few hundred. On his visit in April 1933, he counted less than 100. This may have been partly the result of pasturing cattle on the breeding grounds after 1932, but the fatal cause was the last great massacre perpetrated by the inhabitants in December 1932. None of the inhabitants ever refer to this slaughter but attribute the disappearance of birds to a storm in November 1932. But Mr. Fujisawa, the elementary school-teacher on the island, told Yamada in April 1933 that in December 1932 and January 1933 over 3,000 albatrosses were killed. This last great slaughter was undoubtedly perpetrated by the inhabitants in anticipation of the island's soon becoming a bird sanctuary.

To determine the status of the species at sea, Yamashina asked the Japanese Marine Laboratories and the boats of the Yaizu Fishing Company to collect albatrosses for him on the open ocean between 1933 and 1936. He noted (1942: 248) that the only Steller's Albatross they found was an immature bird taken near Morell, Hawaii, on February 28, 1936. On recent examination of this specimen, however, it proves to be a mature *Diomedea nigripes*.

Torishima also had small colonies of Black-footed and Laysan Albatrosses. According to Yamashina the Black-footed Albatross was always far less numerous on the island than Steller's. He states (1942: 246), "It owes its survival until recent years to the relative unattractiveness of its plumage, and to its nesting sites, which were on the grassy spots on the inaccessible cliffs on the island. Yamada found a colony of about 200 in April 1932, but could find only a few birds in April 1933." Concerning the Laysan Albatross, the same authority (loc. cit.) says, "This species seems to have become a resident of Torishima comparatively recently. The inhabitants told me in 1930 that it first appeared on the island about a dozen years previously. In 1930, the population reached 50, but had decreased to only a couple of birds in 1933."

During Yamada's visit to Torishima in 1932 he banded 22 Steller's Albatrosses on April 9. Eleven of these birds were reported to the Tokyo Government from the same place in November, 1932, and five more on June 30, 1933. Although no details are available, it is assumed these returns were from birds killed by the inhabitants. This is the last unquestionable evidence we have of Steller's Albatross existing in the flesh.

Whether any Steller's Albatrosses ever returned to Torishima after 1933 is not known. If they did, and were not slaughtered by the settlers, who then had to turn from feathers to fish for their livelihood, the island was soon to be made even more untenable for them by another catastrophe. The volcano erupted again in 1939, even more violently than in 1903. The inhabitants were able to escape, but extensive flows buried the birds' former breeding grounds under 30 to 100 feet of fresh lava making them uninhabitable for any albatross which might have survived the massacre.

The main crater overflowed again in 1941. One river of lava flowed down over the cliff into Chitose Bay, the little cove on the northwest corner, which was formerly the island's only anchorage and which gave protection in the old days to the ships as they loaded feathers. This flow filled the little cove completely and the partly sheltered landing place it once afforded is now a forbidding, jagged rampart of black, volcanic rock. Thus Torishima is now more difficult of access than ever before. Except in the calmest weather, the perpetual ocean swells break entirely around its unbroken shore line, regardless of the wind direction.

During World War II, the Japanese maintained on the island an observation and aircraft

warning outpost which was removed immediately after the surrender. The small garrison left behind a legacy of several pairs of house cats, which, at last report, were still managing to survive but were "very wild."

In 1946, at the request of Occupation authorities, the Japanese Government established on Torishima a meteorological observatory, manned by 14 men. It is a lonely and unpopular post, to which supplies and relief personnel are brought by vessel only once every 6 months. Frequently the supply ship has to heave-to off shore and wait for days for the weather to abate sufficiently to allow a landing to be made. Technicians of this weather station report they have observed no albatrosses on the island since their arrival in 1946. However, they state that the slopes now teem with Fork-tailed Petrels (*Oceanodroma markhami owstoni*), millions of which breed in holes under the lava. As is normal with petrels, these birds come to the island only after dark The weather station personnel, noting the birds' tendency to fly to a bright light at night, tell how delicious meals of roast bird can be obtained simply by building a big bonfire after dark and letting the petrels fly into it of their own accord.

I have tried to visit Torishima to look for Steller's Albatross and to judge conditions there for myself ever since my arrival in Japan 3 years ago. However, available transportation never coincided with freedom from other duties during the breeding season until the spring of 1949, when I was able to accompany a whaling catcher on a short trip to the Bonin Island whaling grounds. On our voyage out we passed Torishima after dark. On our return on April 9, however, we reached the south side of the island in mid-morning. But the weather was so rough that the high seas breaking all around the island's 7½-mile perimeter made landing out of the question. Our schedule did not allow us to wait for the wind to abate, so I had to be content with making what observations were possible as we sailed around the island just outside the line of breakers several hundred yards off shore. These observations were sufficient, however, to verify the verbal reports of the weather station personnel that no albatrosses are present on the island.

The only part of Torishima not affected by the recent volcanic activity is the steep northwest slopes where the low buildings occupied by the weather station staff are huddled. Elsewhere, except on the forbidding vertical cliffs, the entire surface of the island is now covered with stark, lifeless, black-gray lava. Where the flow thins out on the northwest slopes, a few dead, white sticks are mute remnants of the brush growth that formerly covered the island. Also on these slopes some sparse grassy vegetation is visible, but there is no sign of those thick reeds, or "makusa," which formerly sheltered the albatross colonies. The main crater is still smoking and fumes issue from cracks and fissures all over the summit of the island.

We saw no albatrosses whatever on or near the island, and very few other birds. On the sheer southern cliffs a few spots of white guano betrayed the scattered roosts of lonesome cormorants. A few solitary gulls scavenged over the surf along the shore. Otherwise, for all we could see, the island was birdless. It will probably be many years before Black-footed and Laysan Albatrosses are able to establish themselves there again, and its once fabulous colony of Steller's Albatrosses may be considered to have vanished forever.

BONIN ISLANDS

Next to Torishima, the best-known colonies of Steller's Albatross were those in the Bonin Islands. Here, it will be remembered, most if not all the eggs in western collections were taken. Apparently these colonies were never as large as the Torishima rookery, or if they were, they had dwindled markedly from the attentions of the feather hunters before any accounts of them were written. The first mention in Japanese literature of Steller's Albatross in the Bonins is S. Yoshiwara's statement (1901: 310) that "Albatrosses are reported as comparatively rare

in the Bonins, but I heard that some come regularly to the Muko-jima Islands. However, it is impossible to hunt them there for feather gathering."

The species may have bred on other of the Bonin Islands, but there is definite evidence for its having nested on only two of them. The first of these is Kita-no-shima, the northernmost islet of the Parry Group,[4] where five eggs in the Yamashina collection were taken in February, 1928. Toku-Taru Momiyama, who spent most of 1924 and 1925 collecting birds in the Bonins, has four eggs from Kita-no-shima given him by local fishermen, three of them taken in early November, 1922, and the other on November 23, 1924. Momiyama was never able to land on this islet during his stay in the Bonins, being prevented from doing so by rough seas every time he tried. He informs me, however, that when he sailed close to it in 1924, he saw only about 30 adult birds on its slopes. Kita-no-shima was designated by the Japanese Government as a "no hunting area" in April, 1926, but the protection, as in all other cases, was never effective, for itinerant fishermen in the neighborhood apparently continued to raid it at will.

The Bonin fishermen also gave Momiyama an egg taken December 1, 1924, and an adult bird taken October 20, 1924, on Nishi-no-shima.[5] Momiyama landed on this isolated islet in April, 1925, but he tells me there were no eggs or young in evidence, and the fishermen with him clubbed the five or six albatrosses they found there the moment they got ashore, before he could stop them, and before he could make any observations.

Kobayashi and Ishizawa (1942: 33) state that the bird bred also on Yome-shima and Muko-shima Islands.[6] No specimen evidence exists to back this claim, and Momiyama recalls seeing no birds on either island during his stay there. However, H. Okabe (1930: 272) gives the following information by one of the residents of Muko-shima, a certain Mr. Iwasaki:

> Two kinds of albatrosses, black ones and white ones, occur on the island. The white one comes in late October, the black one in mid-November. The white one weighs about 7.5 kilograms, the black ones about 5.6 kilograms. The date of egg laying is uncertain, but the egg of the white one weighs 375 grams, that of the black one from 260–300 grams. The white bird builds its nest up in a cone about 15 centimeters high, but the black one only gathers a few dried grasses together to lay its eggs on. The hatching time varies, but I think incubation takes about 7 weeks. The adult birds leave the island in May, and the young leave in June.

I spent several days in late March and early April, 1949, on a whaling catcher boat operating in the vicinity of the northern Bonins. During this time I was able to inspect closely every one of the islands in the group, though the seas were so rough and the winds so high during the entire period that I was able to land only on Muko-shima. We cruised for two days in the Parry Group, sailing around all its islets as closely as possible. With the exception of Muko-shima, all these islands are so small that their entire area is visible from the sea. These islands are now uninhabited, but during World War II, Muko-shima was occupied by a small garrison of about two or three hundred Japanese troops. When the troops were evacuated after the surrender, their barracks were razed, but evidences of occupation still remain in the form of the cement foundations of the barracks, old anti-aircraft gun-pits and machine-gun nests enfilading the possible landing places. The most deplorable evidence of the recent Japanese occupation is the scarcity of bird life on the island. Two endemic Bonin Island land birds, *Zosterops palpebrosa alani* and *Apalopteron familiare familiare*, were formerly abundant on Muko-shima. I hunted for them assiduously during my 4 hours on the island, but could find no trace of either species. They were undoubt-

[4] Muko-jima Retto of the Japanese; Kita-no-shima is located at 27° 43′ N, 142° 06′ E.

[5] This islet was formerly known as Rosario Island and lies in 27° 15′ N, 140° 53′ E, about 80 miles southwest of the Parry Group.

[6] These are larger islands of the Parry Group. Muko-shima is 3 miles, and Yome-shima 15 miles, south of Kita-no-shima.

edly wiped out by the Japanese garrison who probably caught them in mist-nets for food. The only birds on the island were a few scattered pairs of Red-bellied Rock-Thrushes, a wide-ranging species which has undoubtedly returned there since the departure of the Japanese. No albatrosses of any species breed today in the Parry Group.

We spent one day sailing around Nishi-shima, but again were unable to land because of the rough seas. This low island is only about 700 feet long and the seas were so rough and the winds so high that spray was blowing completely over it. I saw large flocks of Salvin's Shearwaters, a few Bulwer's Petrels, Black-footed and Laysan Albatrosses, and a single Spectacled Tern feeding in the tide rips just north of the island. It was obvious, however, that no albatrosses now breed on Nishi-shima.

PESCADORES AND SOUTHERN RYUKYUS

We know from the observations of La Touche (1895), Seebohm, and other early writers that Steller's Albatross was a common winter bird in the waters from China to Formosa and the Ryukyus. But the statements in the *Hand-List of Japanese Birds* (1932 and 1942) that the species breeds in the Pescadores Islands, on Agincourt Island off the northern coast of Formosa, and on Kobisho Island in the southern Ryukyus are backed by indisputable specimen evidence only for the latter locality.

The earliest reference to Steller's Albatross on Kobisho[7] is Kuroda's (1925: 148) remark that "Dr. Tsuneto told me that the bird was very abundant on Kobisho in Senkaku Retto and also on Rasa Island." Kuroda notes that no specimens have been taken at either locality, and makes no mention of the species' breeding. Kobayashi (1930: 371) states, however, "One egg, 118.0 x 77.5 millimeters, of *Diomedea albatrus* from Kobashima [Kobisho], Senkaku Retto, was given me by Mr. Takuya Iwasaki."

The former occurrence of a breeding colony on Agincourt Island,[8] while probable, lacks specimen substantiation. Dr. Kuroda tells me a picture of the rookery on this island, showing clearly identifiable adults and young birds, was published in a brochure on Formosa issued by the Japanese Government of Taiwan about 1895. His copy was lost when his library was destroyed in 1945, and a search through other Tokyo libraries has failed to unearth a duplicate. The only other mention of the species on Agincourt is in the memoirs of Kaju Enomoto, a civil servant formerly employed by the Ministry of Agriculture and Commerce. Enomoto writes (1936: 29) that on April 28, 1901

> I saw Agincourt Island far on the horizon, but our ship did not approach within 4 miles of it, so I could not identify any of the birds on the island. The Captain, who was an experienced man in those waters, told me "Numerous albatrosses live on this island, but you can't find many of them now because it is not the breeding season."

The same Enomoto is apparently the only authority for the statement that Steller's Albatross bred in the Pescadores. In the continuation of his memoirs (1937: 8) he relates

> I once stayed in the Pescadores for about one year when birds were still plentiful. During my stay I had the chance to observe albatrosses. While my observations may not be satisfactory, I regard them as valuable because wild birds have decreased so tremendously in recent Japan, and you can observe albatrosses now in Japan only on far-away Torishima.
>
> It was the last of February in 1902 when I saw the most albatrosses. The weather being calm, I had an opportunity to make a trip on the patrol ship of the local Pescadores government. During the voyage I saw albatrosses crowding on Byo-sho.[9] The hatching season was almost over, and it was the season when the parent birds do not stay on land in the daytime. Nevertheless numerous birds were seen, and I was delighted with the opportunity. But as the

[7] Lat. 25° 56′ N, Long. 123° 42′ E, the northernmost island in the Senkaku Archipelago, a little group of islets about 250 miles southwest of Okinawa and 100 miles northwest of Formosa.

[8] Hoka-sho of the Japanese, 25° 38′ N, 122° 04′ E, about 45 miles due north of Formosa.

[9] A small islet in the extreme southwest of the Pescadores group, 23° 19″ N, 119° 8″ E. [Author's note.]

government officers had no business on this uninhabited island, the ship did not stay long, and I could not land on the island to collect eggs and chicks. It was hard enough to get specimens of adults.

It is also likely that the species may once have nested on other isolated islands south of Japan, from which it was extirpated before authentic record could be made of its presence. Certainly it should have bred on one or more of the Daito Islands[10] where Kuroda (loc. cit.) was told it was "very abundant on Rasa Island."

THE FEATHER TRADE

The decline and probable extermination of Steller's Albatross were caused entirely by human persecution on its breeding grounds, which started about 1885 when the value of its feathers was first realized. The white body feathers of Steller's Albatross were particularly valued by the plume hunters, because they brought the top prices when marketed as "swansdown" for quilts and pillow stuffing. The wing and tail feathers were sold as "eagle feathers" for quill pens, and for millinery and other ornamental purposes. Each albatross yielded about ¼ pound of feathers, worth in those days about 5 sen per pound. This seems little enough, but harvesting them was a profitable business because the birds were so plentiful and labor so cheap.

The revolting details of the nefarious feather trade never have been and probably never will be written in full. It was conducted mostly by illiterate hunters and fishermen and was supervised in its hey-day by close-mouthed business interests concerned only with immediate profits. The first feather hunting was done by casual fishermen, but as the trade proved more and more remunerative, it was taken over by big business. Most of the Japanese feather hunting was supervised by the South Seas Trading Company, which is now defunct. Its records of the feather trade, if they ever existed, and the men connected with it are no longer traceable.

[10] Lat. 24° 28′ N, Long. 131° 11′ E, midway between the Bonins and the Ryukyus.

The trade was abolished by law in America 50 years ago, but not before our egrets and terns were almost wiped out. Protection reached the Hawaiian archipelago just in time to save the famous Laysan colonies, to which the plume hunters were then turning their attention. Yamashina states (1942: 244) that the Japanese Government prohibited the killing of albatrosses in 1907, but the statutes show them to have been legal game birds until the amendments of 1947, and the *Annual Hunting Statistics* published by the Ministry of Agriculture list from 500 to 4,000 "albatrosses" killed each year from 1930 to 1942, the last year for which figures are available. These data, however, are neither accurate nor specific, and undoubtedly refer to the other two species of North Pacific albatrosses. The only protection ever afforded Steller's Albatross by the Japanese was their designation of Torishima and Kita-no-shima as "no hunting areas," and apparently they made no effort to enforce the law on these outlying islands. In both cases the designation was for a 10-year period only, which was not renewed at its expiration.

Japan has never had a law prohibiting traffic in or possession of protected birds or parts thereof, and the import-export trade in feathers flourished in Yokohama as long as birds were available to supply the demand. The accompanying graph shows, from the only figures available, the total exports of feathers from Japan. All sorts of wild birds contributed to this total, which is impossible to break down by species, but feathers from the Pacific sea bird colonies constituted the major portion, and Steller's Albatross, as long as it survived, was one of the most sought sources of supply. Although we hear little about it nowadays, the trade has not died out entirely. A demand for feathers of all sorts still exists, Paris being the main market, but the export center is reported to have shifted some years ago from Japan to Shanghai, China.

VALEDICTUM

We are loath to regard any species as extinct

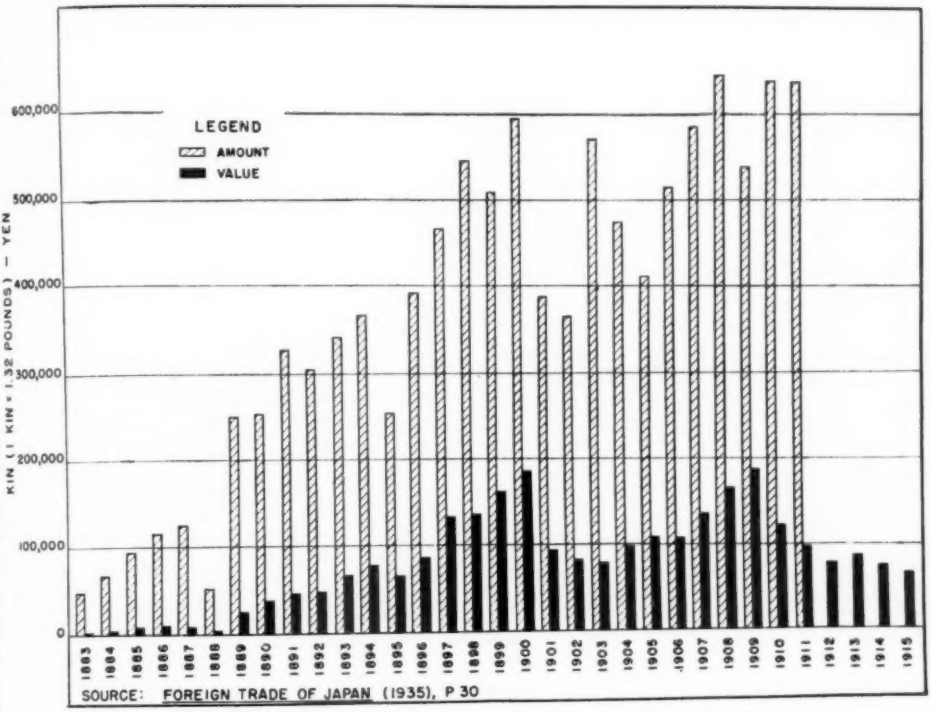

FIG. 1. Export of feathers from Japan.

until every possibility of its survival has been investigated and exhausted. Even then the negative evidence is unsatisfactory, and the hope always remains that in some overlooked corner of the globe the species will once more be found, even as *Notornis* was so recently rediscovered in the mountain fastnesses of South Island, New Zealand.

It is to be noted that Steller's Albatross has been reported several times since 1933, most recently in 1944 and 1945, as having been seen at sea in Alaskan and Aleutian waters on the species' summering grounds. As the species is reputedly a shy bird which seldom follows or comes close to ships, it is difficult to observe except on or near its breeding grounds, and it must be remembered that the species may be confused easily at a distance with the other two North Pacific albatrosses. Adults resemble the Laysan Albatross, but lack its black back; immatures resemble the Black-footed Albatross, but have a flesh-colored instead of a black bill. Hence, sight records made at sea, even by the most careful and reliable observers, must be regarded as doubtful unless amply substantiated.

As mentioned previously, in March and April, 1949, I cruised for 10 days in the southern Izus and the northern Bonin Islands, the best known former breeding grounds of Steller's Albatross. In its normal life cycle we know that this species did not leave the breeding grounds until late May and June, so at the time of my visit any surviving individuals should have been in the vicinity attending their fairly well grown young. I was able to sail within close inspecting distance of every island in this chain on which Steller's Albatross is known to have bred. I also visited every other island in the area which

could possibly support a breeding colony of birds. Needless to say, I studied carefully every albatross that came within sight during the entire trip. If Steller's Albatross were still breeding in this area, I should have seen some sign of it, either on the islands or on the seas nearby. There was no scarcity of Black-footed and Laysan Albatrosses at sea in this area, both seeming to occur in normal numbers, although the Black-footed outnumbered the Laysan about fifteen to one. Despite the most careful watch, I saw no albatrosses close to or on any of the islands, and no sign whatever of any bird that could conceivably be construed as Steller's Albatross during the entire voyage.

The chances that any of these fine birds remain alive today are remote indeed, unless they be a few old individuals perhaps beyond the breeding age, which spend all their time at sea and never come to the breeding islands. Although their known former rookeries are all small isolated islands far off the beaten tracks of commerce, and extremely difficult of access, the waters surrounding them have swarmed with Japanese, Chinese, and Okinawan fishermen for the last 50 years, except for a brief period late in and immediately after World War II. No person interested in birds or able to differentiate between the three North Pacific albatrosses has visited any of the known breeding grounds of Steller's Albatross in the southern Ryukyus and off Formosa. But it is hard to believe that any islet exists in this area which has not been visited many times by Oriental fishing boats in the 16 years since the last known Steller's Albatross was killed. It is equally unlikely that any of these craft would pass by an out-of-the-way island with a bird on it without its crew attempting to land and kill the bird. Policing these islands to prevent such depredations is well nigh impossible, both politically and economically. Although there is always the possibility that a few pairs may remain on some isolated, as yet unvisited islet, it seems only too likely that Steller's Albatross has become one of the more recent victims of man's thoughtlessness and greed.

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A Second Hawaiian Species of *Alectryon* (Sapindaceae): Hawaiian Plant Studies 17[1]

HAROLD ST. JOHN[2] AND LAFAYETTE FREDERICK

THE GENUS *Alectryon* has been known in the Hawaiian Islands by a single species, *A. macrococcus* Radlk. It was first collected by Hillebrand, but, though he found it on two different islands, Molokai and Oahu, he never succeeded in assembling complete material. The binomial was published in 1890, based solely on Hillebrand's incomplete collections and data. Since that time, successive botanists, Rock, Forbes, Degener, and others, have found new localities for the species; it is now known on Kauai, Oahu, Molokai, and Maui. Nevertheless, *Alectryon* is still considered a rare tree. On Kauai it was discovered by Gay, and by Lydgate in Olokele Valley, apparently early in the 20th century, but it has not been found there since. On Molokai it is apparently extinct at the type locality, though Degener found another station only a mile or two away at Puu Makaliilii, where in 1928 there were two dying trees. On Maui it was known from the rich, dry forest at Auahi on Haleakala, where Rock in 1910 found 40 trees. Since Rock's time this rich area has been deforested by cattle grazing. Another station was found by Forbes in Olowalu Valley, west Maui, in 1920, but no one has found *Alectryon* there since. On Oahu it is now known to extend, in the Waianae Mountains, from Pahole Gulch to Ekahanui Gulch, or nearly the full length of that mountain range. Yet, even on Oahu, the trees are few and remote and the discovery of one is a noteworthy event on a day's exploration. Most unusual is the large single or double fruit with its woody pericarp and abundant, juicy, scarlet, edible aril, somewhat resembling those of the related "litchi."

It is now evident that the genus contains more than one Hawaiian species and that the original *Alectryon macrococcus* was described from material assembled from two islands and representing two species. To straighten out this confusion it has been necessary to select a lectotype for the older species and describe the other as a new species.

SAPINDACEAE

Alectryon (§Mahoe) Mahoe St. John & Frederick, sp. nov.

Figs. 1, 2.

Diagnosis Typi: Arbor 7 m. alta, ramis fusci-rubri-brunneis, glabratis, cicatricibus 4.5–6 mm. latis scutiformibus pallide brunneis fasciculis 3, ramulis foliosis 4–6 mm. diametro teretibus adpressi-puberulis, internodis 5–35 mm. longis, foliis 27–42 cm. longis pari-pinnatis, petiolis 6–12 cm. longis adpressi-puberulis, foliolis 2-3-jugis, petiolulis 8–15 mm. longis basi inflata adpressi-puberulis, foliolis 10.5–21 cm. longis 5–10 cm. latis, plerumque ellipticis vel minime lanceo- vel oblanceo-ellipticis rare ovalibus plerumque plusminusve asymmetricibus, apice obtusi, basi rotundata vel abrupte subcuneata, laminis rigide crasse chartaceis fusci-viridibus glabris margine integri plani vel undulati, infra pagina intervallis glabris nervis salientibus adpressi-puberulentis, venulis saliente reticulatis,

[1] This is the seventeenth of a series of papers designed to present descriptions, revisions, and records of Hawaiian plants. The preceding papers have been published in *Bernice P. Bishop Mus., Occas. Papers* 10(4), 1933; 10(12), 1934; 11(14), 1935; 12(8), 1936; 14(8), 1938; 15(1), 1939; 15(2), 1939; 15(22), 1940; 15(28), 1940; 17(12), 1943; *Calif. Acad. Sci., Proc.* IV, 25(16), 1946; *Torrey Bot. Club, Bul.* 72: 22–30, 1945; *Lloydia* 7: 265–274, 1944; *Pacific Sci.* 1: 5–20, 1947; *Brittonia* 6(4): 431–449, 1949; *Gray Herb. Contrib.* 165: 39–42, pl. 3, 1947.

[2] Chairman, Department of Botany, University of Hawaii. Manuscript received June 28, 1948.

venis lateralibus principalibus alternatis uno latere 10–12 arcuati-adscendentibus angulo 120°–145° apicibus venarum juxta margine arcuati-connatis, inflorescentibus axillaribus 9–30 cm. longis, 6–16 cm. latis adpressi-puberulentis, pedunculis 0–52 mm. longis, paniculis conicis, pedicellis 0.5–3 mm. longis, bracteis 1–2 mm. longis subulatis caduceis; floribus evidenter polygamis, specimina typica solo cum floribus hermaphroditis, calycibus 2 mm. altis 2–2.5 mm. diametro valvatis patelliformibus basi truncata dense adpressi-sericeo-puberulentis, lobis 5 inaequalibus anguste deltoideis loba maxima tubam subaequantibus, petalis nullis, staminibus 6–8 intra disci marginem circa pistillum insertis, filamentis 0.4 mm. longis subulatis puberulis, antheris 1.1–1.3 mm. longis elliptici-oblongis 4-locularibus 4-lobatis rubescentibus vel flavescentibus, pistillo 2-loculare basi urceolata e latere evidente compressi exserti dense breve sericeo, stylo gracile circa 0.5 mm. longo, stigmatibus 2 liguliformibus 1 mm. longis rectis deinde recurvatis, fructibus tarde irregulariter diruptis, loculis fructicis 1–2, specimina typica cum fruticibus 1-locularibus 25–38 mm. longis subglobosis laevibus fusci-brunneis, pericarpio duro lignoso pallido in basi 5 mm. crassa in apice 3 mm. crassa, arillo carnoso in stato postmaturo contracto et in apice seminis coronato, semine uno 19 mm. lato 12 mm. alto in apice proximi scutiformi concavi ossei lucide fusci-brunnei, testa lucida coccinea, apice distali rigide spinosi.

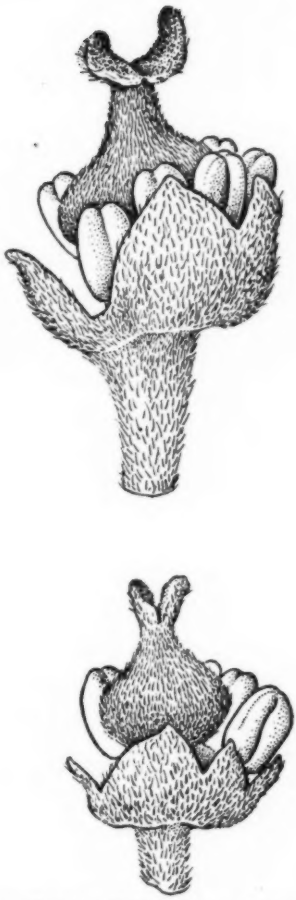

FIG. 1. *Alectryon Mahoe:* older and younger flowers of type, *Frederick & Sakimura 185,* × 10.

Description of All Specimens Seen: Tree 7–10.5 m. tall; branches dark reddish-brown, glabrate, in age the bark pale yellowish-brown, black-spotted; leaf scars 3–6 mm. wide, rounded shield-shaped, pale brown, bundle scars 3; leafy branchlets 4–6 mm. in diameter, terete, appressed puberulous; internodes 5–35 mm. long; leaves 23–54 cm. long, even pinnate; petioles 4.5–18 cm. long, appressed puberulous; leaflets in (1-)-2-3 pairs; petiolules 8–22 mm. long, swollen at base, appressed puberulous; leaflets 9–26 cm. long, 5–11.7 cm. wide, commonly elliptic or slightly lance- or oblance-elliptic, rarely oval, usually somewhat asymmetric, apex obtuse, base rounded or abruptly subcuneate, blade stiff thick chartaceous, dark green, glabrous, margin entire, plane or undulate, lower surface with intervals glabrous, with rib and veins prominent and appressed puberulent, the veinlets raised reticulate, primary lateral veins alternate, 10–17 on a side, arcuate ascending at 120°–145°, inarching and connected near the margin; inflorescences axillary, 9–30 cm. long, 6–16 cm. wide, appressed puberulent; peduncle 0–52 mm. long; panicle

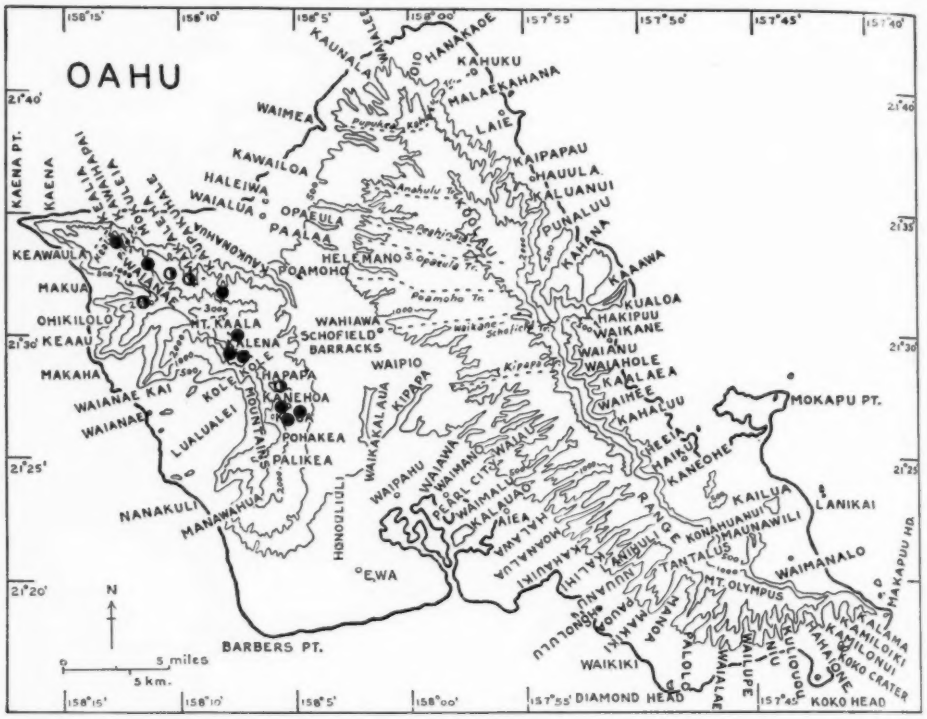

FIG. 2. Distribution of *Alectryon Mahoe*. Solid dots mark localities for specimens with exact data; half-black dots, the probable localities for specimens with incomplete data.

conical, pedicels 0.5–3 mm. long; bracts 1–2 mm. long, subulate, caducous; flowers probably polygamous; but type tree bearing only perfect flowers, these with calyx 2 mm. high, 2–2.5 mm. wide, patelliform, the base truncate, valvate, finely appressed sericeous-puberulent, lobes 5, very unequal, narrowly deltoid, the largest about equaling the tube in length, within the tube attached to an annular disk; petals none; stamens 6–8, inserted on disk at base of pistil; filaments 0.4 mm. long, subulate, puberulous; anthers when dry 1.1–1.3 (when fresh, –1.5) mm. long, elliptic-oblong, 4-lobed, 4-celled, reddish or yellowish; pistil 2-celled, the base urceolate, well exserted, densely short sericeous; ovary distinctly flattened perpendicular to the septum, tapering into a slender style about 0.5 mm. long; stigmas 2, strap-shaped, 1 mm. long, erect, later recurving; the staminate flowers with calyx 1.5–1.8 mm. high, 2.6–3 mm. wide, kneepan-shaped, finely appressed, short sericeous, slightly asymmetric and unequally 5-lobed, the lobes from half as long to nearly as long as the tube; stamens 9–13, filaments 0.2 mm. long, filiform; anthers 1.1–1.3 mm. long, oblong; pistillode 1 mm. long, broadly ovoid, densely sericeous; the fruit tardily irregularly rupturing, either maturing only one cell with a remnant of the partially developed second cell fused to it or maturing both cells and appearing like twin balls; single-celled fruit 25–43 mm. long, subglobose, smooth, dark brown; 2-celled fruit 30–47 mm. long, 40–70 mm. wide; pericarp hard woody, pale, at base

5–10 mm. thick, at apex 2–3 mm. thick; aril fleshy, scarlet, edible, "resembling peach in flavor" (*fide* Degener), shrivelling to a crown on the distal end of the single seed; seed 19–30 mm. wide, 9–12 mm. high, at hilum or proximal end shield-shaped, concave, hard and polished, dark brown, the testa scarlet, shiny, the distal end bearing the aril is produced into short spine-like processes.

Type: Hawaiian Islands, Oahu: Puu Kanehoa, South Huliwai Gulch, 2,100 ft. elev.; in open forest with *Neraudia* sp., *Fagara semiarticulata,* and *Planchonella* sp.; tree 30 ft. tall, 6 in. in diameter; Aug. 21, 1947, *L. Frederick & K. Sakimura 185* (fl. fr.) (Bishop Mus.).

Specimens Examined (the list of specimens is arranged in geographical order from north to south; abbreviations—b.=bud, fl.=flower, fr.=fruit): Oahu, Waianae Mountains: Makua Valley, southeast corner, on moderately dry forested slope, Sept. 27, 1932, *O. Degener & C. Judd 9538* (fr.); Mokuleia Trail, alt. 2,100 ft., tree 22 ft. tall, 4 in. in diameter, open forest, July 13, 1947, *L. Frederick 183* (b.); Mokuleia, near head of right branch of Pahole (Kukuiula) Gulch, moist forest, alt. 550 m., April 12, 1936, *F. R. Fosberg 13069* (fr.); Mokuleia, left branch, slopes of Kaala, April 26–May 16, 1912, *C. N. Forbes 1768-O* (fr.); Makaleha Valley, west side of, dense forest near stream, first discovery of staminate flowers, July 21, 1935, *O. Degener et al. 10906* (fl.); Makaleha (or "pali of Kalaupapa, Molokai"—but this a confusion of data), *W. Hillebrand & J. M. Lydgate;* Kamokukui Valley (between Puuiki and Puu Kamaohanui), large forest tree, April 12, 1933, *O. Degener 9535* (fr.); Mt. Kaala, base of, near end of Schofield Fire-Break Trail, dense wet forest, 4 trees seen up to 35 ft. high, March 13, 1932, *O. Degener et al. 9537;* Puu Kaala, Waianaeuka, wooded gulch, 2,000 ft. alt., tree, Jan. 8, 1933, *H. St. John & J. Dunn 12920;* Puu Kalena valley S. of E. ridge of, moist forest, alt. 750 m., tree 7 m. tall, March 22, 1936, *F. R. Fosberg 12987* (fr.); Puu Kumakalii, northeast slope of, forest, April 1, 1936, *O. Degener 11111;* Kanehoa, Honouliuli, el. 700 m., tree, 7 m. in height, steep north slope, Oct. 25, 1927, *C. S. Judd 66* (fl.); Kanehoa, Oct. 1929, *G. W. Russ* (b. fr.); Ekahanui, rich forest, April 21, 1936, *O. Degener & M. Martinez 11108* (b.), *11109* (b.); South Fork of Ekahanui Gulch, Puu Kaua, Honouliuli, 2,300 ft. alt., wooded ridge, young tree 4 m. × 5 cm., Feb. 27, 1938, *H. St. John 18684* (fr.); Ekahanui Gulch, Fire-Break Trail, Puu Kaua, Honouliuli, 1,760 ft. alt., lower forest remnant, tree 6 m. × 8 cm., Feb. 29, 1948, *H. St. John 23356* (fr.).

Waianae Range, without data: *O. Degener* (fr.).

There was also a collection from second gulch E. of Puu Kaupakuhale, N.E. slope of Puu Kaala, Mokuleia, Oct. 23, 1932, *St. John & Fosberg 12144* (fr.), but this specimen cannot now be located.

The published record (Hosaka, 1937: 224) of this tree from Kipapa Gulch is the only record for the Koolau Range. This rests only on a field observation, as the single large tree was never seen in flowering or fruiting condition.

Although there are numerous collections of this new species, most of them show only fruit or flower. The collection *Frederick & Sakimura 185* is chosen as the type because it has foliage, numerous flowers, and three good fruits, all taken from a single tree.

The new species, *A. Mahoe,* is being separated from *A. macrococcus* Radlk. which was based on the material collected by Hillebrand and on the description of his probable new genus, *Mahoe.* Hillebrand had made a collection on the "pali of Koolaupapa" [precipice of Kalaupapa], Molokai, consisting of leaves with old fruit of the previous year; and he had another collection, with leaves only, from Makaleha Valley, Oahu. Lacking flowers and complete material, he conservatively put a question mark beside his new generic name and refrained from publishing a specific name. Having only this same incomplete material, Radlkofer gave it a specific

name and placed it in *Alectryon.* His description is very brief, mentioning only that the large, usually 1-celled fruit is 3 cm. in diameter; the leaflets up to 26 cm. in length, 11 cm. wide; and that the hypodermis of the lower leaf surface is distinctive. Though these few characters could have been selected from the lengthy description given by Hillebrand, it is certain that Radlkofer studied the Hillebrand specimens in Berlin, for the Hillebrand sheet with a leaf and old fruiting branches, labeled "Mahoe, pali of Koolaupapa, Molokai." bore the note in Radlkofer's writing, "*Alectryon macrococcus* m. [ihi] Radlk." We now designate this Hillebrand sheet in the Berlin Herbarium as the lectotype of *A. macrococcus* Radlk. It was probably destroyed in the bombing of Berlin in 1943, but Figure 3 shows the sheet as it appeared when photographed by St. John in 1935.

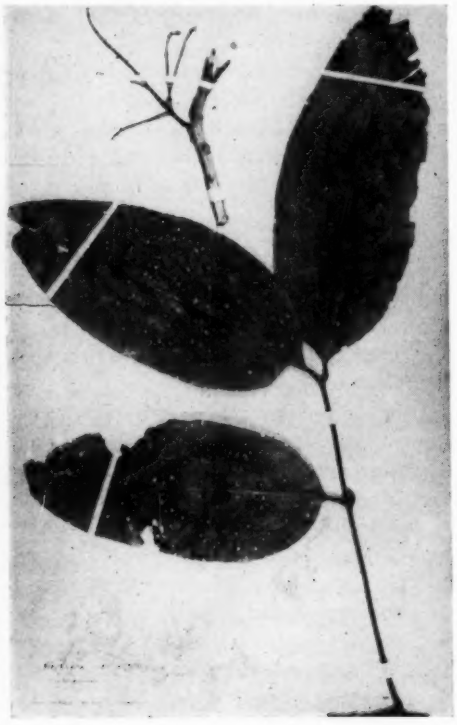

FIG. 3. *Alectryon macrococcus:* photo of lectotype in Berlin Herbarium, "pali of Koolaupapa," Molokai, Hillebrand.

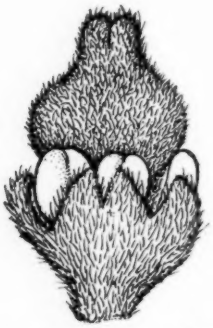

FIG. 4. *Alectryon macrococcus:* flower, Haleakala, Maui, 2,600 ft., J. F. Rock, Nov. 1910, × 10.

A. macrococcus Radlk. of Molokai is distinguished by having the leaflets 11–18.5 cm. long, lance-elliptic, densely soft yellowish pilosulous below; perfect flowers with the calyx campanulate (Fig. 4); style scarcely evident; the stigmas short, erect, not diverging. The collections from Maui are very similar and are confirmed as conspecific with the true *A. macrococcus* of Molokai, and they furnish perfect flowers, with anthers only 0.5 mm. long.

In contrast, we find that *A. Mahoe* has the leaflets 9–26 cm. long, commonly elliptic (or slightly lance- or oblance-elliptic, rarely oval), except for the main veins the lower surface glabrous; perfect flowers with the calyx kneepan-shaped, the base truncate (Fig. 1); anthers 1.1–1.5 mm. long; style slender, evident. These differences seem sufficient to justify the separation of the Oahu plant as a new species. Its specific name is the Hawaiian vernacular one, "mahoe," meaning twins, in allusion to the often twinned fruit.

The illustration by Degener in his *Flora Hawaiiensis* of material which he called *A. macrococcus* from Makua, Oahu, is a good representation of fruiting *A. Mahoe,* but his description is a composite of the two Hawaiian species.

There are in the Bishop Museum two sheets of a collection from the island of Kauai: Olokele Valley, J. M. Lydgate, with stems, leaves, and a

single 1-celled fruit. This seems very like *A. Mahoe* of Oahu, but until more complete material is available, it seems unwise to assign it definitely to a species.

Radlkofer in his monograph of the genus (1933: 983) states that the flowers of the genus are falsely polygamous, that is, are male or female, often in the same inflorescence, and that they are falsely stated to be in part perfect. *A. Mahoe* has numerous examples of trees with all perfect flowers, and one example with all staminate flowers, so the generic description should now be altered to allow male, female, or perfect flowers.

A summary of the synonymy of the only other Hawaiian species is as follows:

Alectryon macrococcus Radlk., K. Bayer. Akad. Wiss., Math.-Phys. Kl., Sitzber. 20(1): 255, 1890 (as to Molokai plant); *Mahoe ?* sp., Hillebrand, Fl. Haw. Is. 86–87, 1888 (as to Molokai plant); *A. macrococcus* Radlk., Radlk. & Rock, Hawaii Bd. Commrs. Agr. and Forestry, Div. Forestry, Bot. Bul. 1: 3–4, pl. 1, 1911 (as to Molokai and Maui plants, the plate being of the Maui plant); Rock, Hawaii Bd. Commrs. Agr. and Forestry, Rept. for 1910: 81, pl. 19, 1911; Rock, Ind. Trees Haw. Is. 277–278, pl. 107–108, 1913 (as to Molokai and Maui plants); Radlkofer, in Engler, Pflanzenreich IV, 165(5): 987–988, 1933 (as to Molokai and Maui plants); Degener, Fl. Haw., fam. 210, text 5/5/'37 (as to Molokai and Maui plants; not as to the Oahu plants or the figure based on a plant from Oahu). *Dodonaea* sp., Drake del Castillo, Ill. Fl. Ins. Mar. Pacif. 6: 144, 1890, in notes under *Dodonaea viscosa,* which is his disposition of *Mahoe* of Hbd.

The generic name was first published in 1788 by Gaertner, with the single species *Alectryon excelsum,* thus indicating that he considered the name to be neuter. Other authors accepted this gender until it was changed to masculine by the monographer Radlkofer (1890: 256). Our present International Rules (Amsterdam) validate this treatment, the choice and adoption of one of the two classic genders, under Art. C.72 (1). The Greek word, *alectruon,* cock, or hen, is masculine or feminine. Gaertner said the fruit was compressed above like a comb—that is, a cock's comb. Hence, Radlkofer, using this indication, adopted the genus as a masculine one, changed the older specific names to masculine, and made all his new specific names masculine. This discussion of the gender is included as various contemporary botanists still retain the generic name as a neuter one.

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——— 1933. Sapindaceae, in Engler, A., *Das Pflanzenreich IV,* 165: 1–1002. Wilhelm Engelmann, Leipzig, 1931–1934. [Part 5, containing the genus *Alectryon,* is dated 1933.]

The Hawaiian Tun Shells

SPENCER TINKER[1]

INTRODUCTION

THIS ARTICLE is a brief presentation of information on the Hawaiian tun shell fauna (Doliidae), including synoptic keys, descriptions and illustrations of the different species, and notes on their ecology and distribution.

Included in this paper are two species which the author believes to be previously unknown from the Hawaiian Islands. These species are the spotted tun shell, *Tonna dolium* Linnaeus, and the oil jar or channeled tun shell, *Tonna canaliculata* Linnaeus. No prior records of the occurrence of these species in Hawaiian waters are known. None of the local private collections seen or the several collections in the Bernice P. Bishop Museum and in the United States National Museum included any specimens from Hawaiian waters. It is somewhat astonishing that two species of mollusks of this size should not be represented in any of these Hawaiian collections, some of which are very large and quite complete.

The Doliidae, or tun shells, as the group is often called, is a small group, old and well established, and its members are quite easily recognized by the characters which they present. Of these characters the most significant are the large, light, ventricose shells with spiral ribs and furrows. In distribution the Doliidae is an Indo-Pacific group and all of its species, with the exception of *Tonna perdix* Linnaeus, are found within that area.

THE HAWAIIAN DOLIID FAUNA

Species: The Hawaiian doliid fauna is a small one consisting of but five species which represent about one-fourth of those now known. Of these five species, four are Indo-Pacific in their distribution and one, *Tonna perdix* Linnaeus, is circumtropical. The following species are known from the Hawaiian Islands:

Tonna perdix Linnaeus, the partridge tun
Tonna melanostoma Jay, the black-lipped tun
Tonna dolium Linnaeus, the spotted tun
Tonna canaliculata Linnaeus, the channeled tun, and
Malea pomum Linnaeus, the apple tun.

Ecology: Although the Hawaiian Islands border the Indo-Pacific faunal area and draw the major portion of their shore line fauna from this region, the Indo-Pacific species are not as well represented in Hawaiian waters as in the more centrally located areas of the region. This apparent dearth of species is probably due to the facts that the Hawaiian Islands lie on the extreme northern edge of this region, have a somewhat different ecological picture, and that the shore lines of the Hawaiian Islands have not been adequately explored beyond the depths comfortable for ordinary diving. In Hawaiian waters, at least, the members of this family appear to be uncommon in depths of less than 40 or 50 feet, although occasional specimens of *T. perdix* L. are found in depths of less than 10 feet. At depths beyond 75 feet the number of individuals of *T. perdix* L., *T. dolium* L., and *Malea pomum* L. increases considerably and it is beyond this depth that the two additional new records have been obtained.

Not only does the Hawaiian doliid fauna become more abundant with increasing depth, but it is not uniformly distributed along the shore line: it appears to be more abundant in particular areas. One such area where both species and specimens are especially abundant exists along the southwestern shore of Oahu, and it is from this locality that the two new records were obtained. The reason for the abundance of these species in certain areas is unknown, but it should be noted that the area

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mentioned is one in which no well-defined reef exists. It is, moreover, the point on the island of Oahu which is nearest to deep water, the remaining parts of the island shore line being separated from deeper waters by an insular shelf some miles in width.

Distribution: The distribution of the species in the Hawaiian Islands is not well known, but it can be said with some degree of assurance that the species previously known from this area are distributed from Hawaii northwestward to Ocean or Kure Islands, inasmuch as specimens are on record from several points along this chain. The range of the two species here newly recorded is unknown and their present scarcity will make their true distribution in the Hawaiian Islands unknown for many years.

Family DOLIIDAE

Shells large, ovate, thin, hard, with large ventricose body whorls, spirally ribbed, without longitudinal sculpture; aperture very large; spire short and small; umbilicated; anterior canal present, but short; outer lip simple; operculum absent in adult, thin and corneous in young; length, 2 to 9 inches.

The mollusks which inhabit these shells are fascinating to watch for they are large and muscular creatures and active in their habits. The foot is large and fleshy and when expanded is more than twice the diameter of the aperture. The head bears a pair of elongated tentacles which are expanded basally and have eyes near their proximal end. The head bears in addition a long, large, cylindrical, tube-like proboscis which is extensible and very flexible and which ends in a kind of rosette. When undisturbed the mollusk glides rapidly along. The proboscis is held in a forward, slightly raised position forming a gentle S-shaped curve with the free end directed downward, and is waved slowly from side to side.

Key to the Genera and Species of Hawaiian Doliidae

1. Shells light in weight, thin, hard; outer lip simple; body whorl large; aperture very wide (Genus *Tonna*) 2
   Shells heavier; outer lip strongly dentate; body whorl less expanded; aperture considerably reduced, approximately four times as long as wide ..... *Malea pomum* Linnaeus.
2(1). Outer surface of shell marked by a regular recurring color pattern 3
   Outer surface of shell variously pigmented without a regular recurring color pattern, blotched and streaked with various shades of black, brown, and yellow 4
3(2). Outer lip of shell crenate; outer surface of shell white in color, marked upon the ridges by quadrate brown spots; spiral ridges well developed, approximately as wide as the interspaces ..... *Tonna dolium* Linnaeus.
   Outer lip without crenations; outer surface of shell brownish in color, usually covered by a network of white lines consisting of regular narrow spiral lines which follow the grooves and which are connected by short, irregular, longitudinal lines crossing the ribs; spiral ribs present, but poorly developed ..... *Tonna perdix* Linnaeus.
4(2). Inner and outer lip of aperture marked with black; spiral grooves on outer surface of shell marked with black; ribs on outer surface of shell arched ..... *Tonna melanostoma* Jay.
   Inner and outer lip of aperture not marked with black; spiral grooves on surface not marked with darker lines; ribs on outer surface of shell nearly flat ..... *Tonna canaliculata* Linnaeus.

Genus TONNA Bruennich

Shells large, ovate, thin, hard, with greatly inflated body whorls; surface of shell spirally furrowed and ribbed, without longitudinal sculpture; spire low; aperture large; outer lip simple, with or without crenations; columellar lip broadly expanded; umbilicated, open or closed; operculum absent in adult, present in young.

This genus includes about 21 species of which approximately one-third are fossils. Four species are known from the Hawaiian Islands.

Tonna perdix Linnaeus

Description: Shell ovate, thin, large, hard; whorls about six in number; body whorl greatly inflated centrally, encircled by approximately 20 very low, wide, contiguous, spiral ribs; spire not appreciably depressed, longer than in other species; aperture large, somewhat oblique; outer lip simple, thickened, without crenations; columella arched somewhat, but not twisted; color usually reddish-brown, marked by a reticulated pattern of white lines; inner margin of lips white; length, 2 to 6 inches.

This species differs from all other members of the family in its longer spire and more oblique aperture.

The color of this species is not uniform, nor is it enduring. Specimens are known which lack the usual color pattern and, instead, exhibit a nearly uniform coloration over the entire outer surface of the shell. The coloration does not seem to be permanent, for many specimens in collections seem to become progressively lighter with age. This fading appears to be increased by exposure to light.

Ecology: This species is by far the most common in Hawaiian waters, being apparently at least twice as abundant as all other species combined. It ranges in depth from less than 10 feet to well over 100 feet and is much more common at the greater depths.

Distribution: Circumtropical, including the Hawaiian Islands.

Tonna melanostoma Jay

Description: Shell ovate, large, thin, hard; whorls about seven in number; body whorl greatly inflated centrally, encircled by 18 to 20 well-defined convex ribs with or without smaller intervening ridges; spire moderately well developed, proportionately shorter than *T. perdix;* aperture large, emarginate basally; outer lip simple, crenate, not thickened; columella expanded, reasonably straight, somewhat twisted, calloused; color of exterior white, yellow, brown, and black, darker in older specimens, grooves darker than intervening ridges; color pattern irregular but forming poorly defined longitudinal bands of brown, yellow, and white; outer lip marked by black; inner lip marked by black area which becomes large, dark, and shining in older specimens; length, 2 to 9 inches.

Ecology: This species is second to *T. perdix* in abundance in Hawaiian waters. It does not seem to invade the shallower areas along the shore line as does *T. perdix* although specimens are not unknown in this area.

This species, like all other shells of this family, is attacked by hermit crabs, including in particular *Dardanus asper* deHaan, the most common of the larger hermit crabs; *Dardanus punctulatus* (Olivier), a large red species measuring as much as 12 inches in length; and another large, white, unidentified species.

Distribution: Indo-Pacific area including the Hawaiian Islands.

Tonna dolium (Linnaeus)

Description: Shell ovate, large, thin, hard; whorls about six in number; body whorl greatly swollen centrally, encircled by 12 to 16 well-defined spiral ribs which are separated by grooves of the same width with or without a smaller median spiral ridge in each groove; aperture large; outer lip simple, crenate, not thickened; spire normal, with sutures slightly depressed; columella reasonably straight, somewhat twisted; color white or bluish-white, marked by quadrate brown spots upon the ridges, these spots being separated by a distance equal to their width; color of grooves darker than intervening ridges; length, 3 to 5 inches.

Ecology: This species is fourth among the tun shells in abundance in Hawaiian waters. It is a rare form and is known only from those specimens mentioned below, all from the same locality. These specimens were procured by Fernando Leonida, a fisherman who operates a set of wire fish traps along the southwest shore of Oahu, and were taken from these wire traps at the outer edge of the reef platform at depths of approximately 15 fathoms. At the time of their capture, all of the specimens were occupied by various species of hermit crabs, a fact which accounts for the presence of the shells

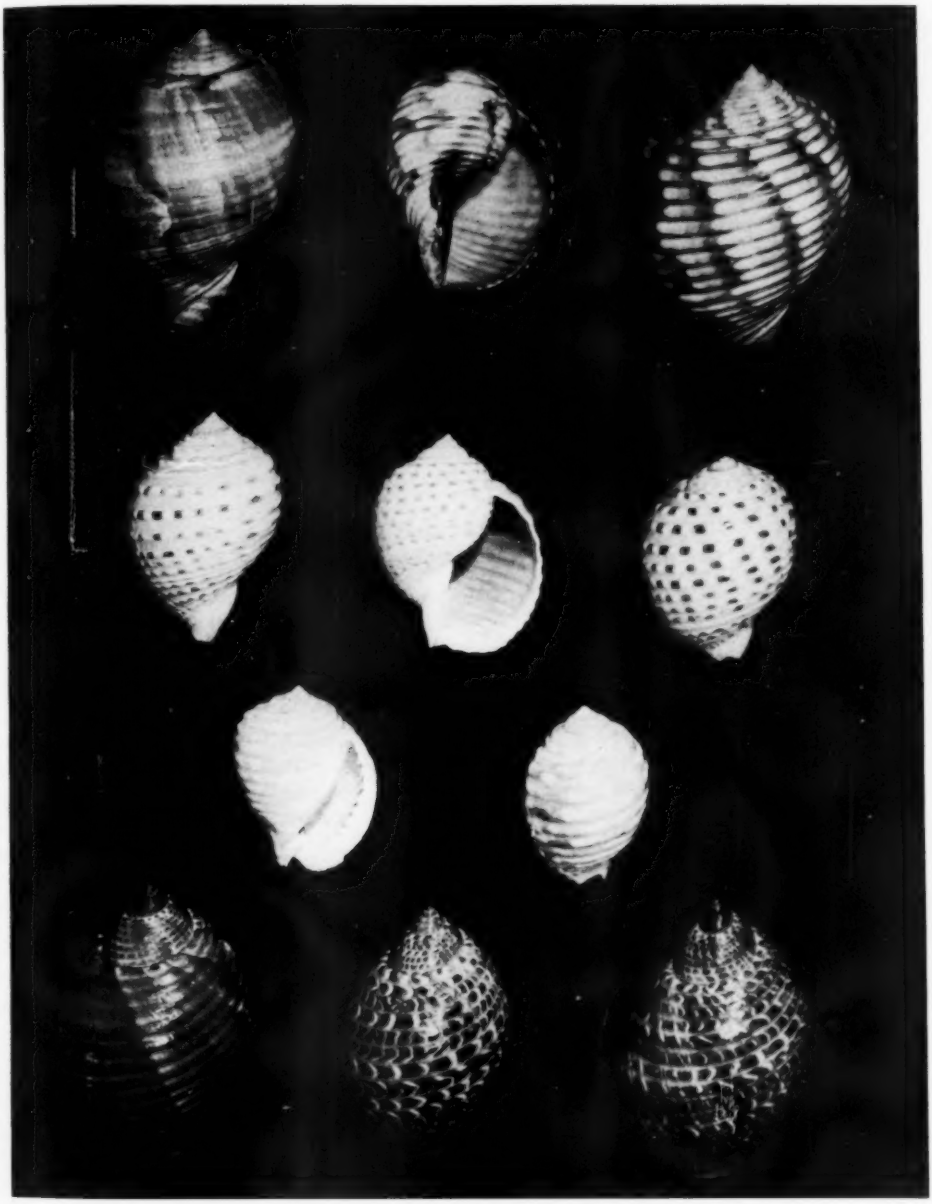

PLATE I. HAWAIIAN TUN SHELLS

Top row: Left, *Tonna canaliculata* Linnaeus. Center and right, *Tonna melanostoma* Jay.
Second row: *Tonna dolium* (Linnaeus).
Third row: *Malea pomum* Linnaeus.
Bottom row: *Tonna perdix* Linnaeus.

in the fish traps. The shells were covered over the outside and about the aperture by a large and fairly common species of sea anemone, *Calliactis armillatas* Verrill (Sagartidae). Although many of the specimens are not in perfect condition, the characteristics of all of them show well enough to permit identification.

Distribution: Indo-Pacific area and the Hawaiian Islands. The occurrence of this species in Hawaiian waters is believed to be unrecorded. A series of more than 25 specimens from the southwestern shore of Oahu has been studied. The Hawaiian specimens from this locality have been distributed to permit their widest use and may now be observed in the following collections: the United States National Museum in Washington, D. C., the Science Museum of the California Academy of Sciences in San Francisco, and in the collections of the Bernice P. Bishop Museum, Ditlev Thaanum, Dr. C. M. Burgess, Dr. Vernon Smith, Arthur Wriston, Charles Allen, and the author, all of Honolulu.

Tonna canaliculata Linnaeus

Description: Shell ovate, large, thin, hard, greatly expanded; whorls about seven in number; body whorl greatly expanded centrally, encircled by about 19 broad, closely set, flat, spiral ribs, separated by comparatively narrow and shallow interspaces, marked at the sutures by a deep channel; columella reasonably straight, but slightly twisted; lip simple; color tawny yellow exteriorly, ribs lighter in color, grooves darker, body whorl becoming increasingly darker toward the lip; length, 3 to 5 inches.

Ecology: This species is the rarest of the tun shells in Hawaiian waters, being known in this locality from a single specimen. It is apparently entirely absent in shallow water and very rare at depths of less than 100 feet. The single specimen was occupied by a hermit crab which had carried it into a wire fish trap at a depth of about 15 fathoms.

Distribution: Indo-Pacific area including the Hawaiian Islands. The occurrence of this species in Hawaiian waters is based upon a single specimen from the southwestern shore of Oahu in the collection of the author. This is believed to be the first record of this species from the Hawaiian Islands.

Genus MALEA Valenciennes

Shell ovate, thin, hard, relatively heavier; whorls less expanded; umbilicated; outer lip simple, outwardly reflected, dentate; aperture reduced.

A single species is known from the Hawaiian Islands.

Malea pomum Linnaeus

Description: Shell ovate, comparatively thin and hard but less so than in genus *Tonna;* whorls about six in number; body whorl moderately large and expanded, but less than in *Tonna,* encircled by about 12 well-defined, low, spiral ribs; spire short; sutures not depressed; outer lip dentate within, reflected flatly outward, somewhat thickened; columellar lip denticulate or wrinkled; columella very slightly excavated at the base; color white, marked with amber of varying intensity and arranged so as to appear spotted with white upon the ridges; lips white; length, 1 to 3 inches.

Ecology: This species is the smallest tun shell in Hawaiian waters and the third most abundant, being exceeded in numbers by *T. perdix* and *T. melanostoma.* It is most abundant at depths approaching 100 feet but is occasionally taken in shallower water. It is apparently not as readily sought out by hermit crabs as are the larger species possibly because the dentition of the shell reduces the aperture and restricts movement, or because the shell is heavier to carry and less easily trimmed at the lip to fit the needs of the crabs.

Distribution: Indo-Pacific area from the Red Sea to eastern Polynesia and the Hawaiian Islands.

The author acknowledges with pleasure the assistance of Dr. Harald Rehder, Ditlev Thaanum, and Wray Harris in problems of distribution and taxonomy, and the help of Charles Allen, Mrs. Ruth Porter, Kenneth Wong, and Wing You Tong in the preparation of the photograph.

Factors Influencing the Development of Lateritic and Laterite Soils in the Hawaiian Islands[1]

G. Donald Sherman[2]

The parent materials of the soil of the Hawaiian Islands have weathered under climatic conditions which are favorable for the development of lateritic and laterite soils. Cline (in press), in his classification of Hawaiian soils, has recognized the following four groups of lateritic and laterite soils: (a) low humic latosols—a group of soils which have developed in regions having a rainfall ranging from 15 to 80 inches. These soils have silica to sesquioxide ratios varying from 1.3 to 1.8; (b) humic latosols—this group of soils has developed in areas having a rainfall from 60 to 150 inches. These soils have developed silica to sesquioxide ratios varying from 0.5 to 0.8; (c) hydrol humic latosols—these soils are found in the regions receiving a very heavy rainfall, 120 to 300 inches. The silica to sesquioxide ratios of this group of soils vary from 0.3 to 0.6; and (d) ferruginous humic latosols—soils belonging to this group have a concentration of heavy minerals in the A_2 horizon. These soils have developed in regions receiving a relatively wide range of rainfall, 25 to 150 inches. The silica to sesquioxide ratios of these soils show great variation, ranging from 0.05 to 1.0.

Each group of soils possesses clays which have distinct and definite chemical properties and these properties were used as a basis for the classification of lateritic soils into the four groups. Since each group of these soils occurs in regions having different climatic conditions, it is likely that climate plays a major role in development. Since the geological ages of the parent materials vary greatly, the time of exposure of the parent material to soil-forming processes will also have had a major effect on soil development. Due to the great variation of the age of the soil parent material, and the great variation in climate due to the effects of elevation and trade winds on temperatures and rainfall regions, a very complex pattern of soil development has resulted. It is the object of this paper to consider the effects of climate and age on the development of lateritic and laterite soils in the Hawaiian Islands.

Review of Literature

Most of the research work involving Hawaiian soils has had for its objective the solution of agronomic problems. Kelley and his coworkers (1912, 1914, 1915) have published several papers on the general chemical composition of certain Hawaiian soils. Moir (1935), in reviewing the work on chemical composition, has concluded that Hawaiian soils have lost a large portion of their silica.

More recently, Hough and Byers (1937) have reported data from a very complete chemical analysis of soils from seven Hawaiian soil profiles. These workers pointed out the very uniform composition of the profiles of the red soils (low humic latosols) and suggested that the clay of these soils was of the kaolinite type. Their data also revealed an unusually high titanium oxide content. Later Hough *et al.* (1941) reported the chemical composition of 21 soil profiles which were selected to range in length of time of weathering from very recent to very old. From the data obtained, these workers suggested that Hawaiian soils were the products of the soil-forming process called podsolization, and were, therefore, podsolic. They based their hypothesis on the following points: first, the

[1] Published with the approval of the Director of the University of Hawaii Agricultural Experiment Station, Honolulu, T. H., as Technical Paper No. 179.

[2] Department of Soils and Agricultural Chemistry, University of Hawaii Agricultural Experiment Station. Manuscript received May 9, 1949.

parent materials of Hawaiian soils, basalt and trachyte, are relatively free of quartz, so that quartz could not accumulate in the A horizon; second, there is an accumulation of titanium oxide in the A horizon of Hawaiian soils. It was their assumption that titanium minerals are resistant to weathering and would, therefore, accumulate where quartz would normally be found in a podsolic profile.

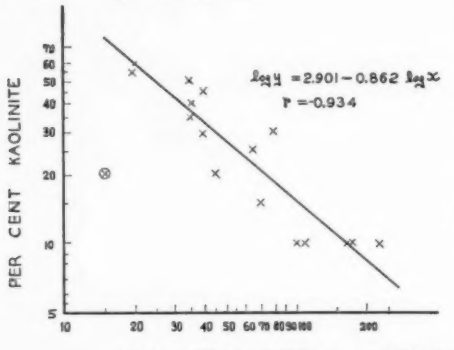

FIG. 1. The relationship between the kaolinite content of the soil colloid and mean annual rainfall.

Dean (1947) and Tanada (1944) have shown that a high kaolinite content in Hawaiian soils developed in regions receiving 25–35 inches of rainfall annually and that the kaolinite content decreased with increasing rainfall. This relationship between rainfall and kaolinite content is illustrated in Figure 1. Subsequent work has shown that the kaolinite content in certain Hawaiian soils (ferruginous humic latosols) decreases with age regardless of the amount of rainfall under which the soil has developed (Sherman *et al.*, 1949). The results of work in our laboratories have supported the hypothesis that in the weathering of tropical soils two weathering processes are ocurring, namely, clay mineral formation (kaolinization) from the decomposition of primary minerals of the soil parent material, and clay mineral decomposition with free oxide accumulation from the decomposition of the kaolinite type of clay minerals. The recent publications from this Station (Sherman *et al.*, 1949, and Fujimoto *et al.*, 1949) have described soils belonging to the ferruginous humic latosol in which the kaolinite clay minerals have undergone almost complete decomposition resulting in the development of soil horizons having a high concentration of iron and titanium oxides. Hematite, goethite, and anatase have been identified as the dominant minerals occurring in these horizons.[3] The decomposition of the kaolinite and the accumulation of these free oxides of secondary origin have occurred under a rainfall of 35 inches per annum and thus can be attributed only to age.

Mohr (1944), in describing the factors which influence soil weathering in tropical regions, has placed considerable emphasis on the part played by rainfall distribution, profile drainage, and age or time of exposure to soil forming processes. He has divided the types of rainfall distribution into five groups, depending on the number of months receiving an average monthly rainfall of less than 60 mm. (which are classified as dry months) and the number of months receiving an average rainfall higher than 100 mm. (which are classified as wet months). His groups range from regions in which most of the months are classified as dry, to regions which are predominantly wet. Closely associated with the distribution of rainfall is the type of water movement in the soil. This is extremely important in tropical regions since the internal drainage soils may be restricted due to formation of impervious clay layers. Under appreciable rainfall this can produce conditions which result in the upward movement, from the zone of saturation, of a considerable portion of the water entering the soil and the lateral movement of water through the horizons of soils which have developed on slopes.

Mohr (1944), in his discussion of the age of soils, recognizes five stages of soil weathering. The five stages of soil weathering which he feels every soil must pass through are fresh, juvenile, virile, senile, and "laterite." According to his hypothesis, the end-product of tropical soil

[3]Cooperative studies with Dr. M. L. Jackson, University of Wisconsin.

weathering will be the iron oxide "laterite crust" as the surface soil and a layer of bauxite as the subsoil.

The soil associations which occur in the Hawaiian Islands appear to fit into several phases of Mohr's hypothesis of tropical soil weathering. The distribution of rainfall in the Hawaiian Islands fits all five of Mohr's groups. Laterization is occurring in soils which have developed in areas which are predominantly dry, those which have alternating wet and dry seasons of variable duration, and under predominantly wet and continuously wet conditions. Also there is good evidence that examples of all five stages of soil weathering described by Mohr do exist in the Hawaiian Islands. The recent discovery of a soil horizon resembling the "laterite crust" supports this contention (Fujimoto *et al.*, 1949).

RELATIONSHIP OF SOIL GROUPS TO RAINFALL DISTRIBUTION IN THE HAWAIIAN ISLANDS

The Hawaiian soils which are developed by the soil-forming process, laterization, occur under a wide range of rainfall. Casual observations would suggest that each of the latosol groups occurs under rather definite regions of rainfall distribution. Further inspection of the actual rainfall for each month at different locations on the island of Oahu revealed a similar rainfall distribution for soils belonging to each latosol group. The data given in Table 1 were obtained by classifying the rainfall distribution of the regions where each soil group is developed according to the wet and dry months proposed by Mohr (1944). The data show that the soils belonging to the low humic latosol and the ferruginous humic latosol have a definite dry season. The lack of a clear-cut difference between the rainfall distribution would suggest that the ferruginous humic latosol may develop from the low humic latosol with age. The humic and hydrol humic latosol have developed under continuous wet conditions. The data include the number of very wet months, or the months receiving more than 8 inches of rainfall. This information is given to show the very wet condition under which the hydrol humic latosols are developed. The chemical analysis of soils has revealed a marked difference in the composition of soils developed in the regions having a definite dry season and of the soils developed under continuous wet conditions. The

TABLE 1

THE RELATIONSHIP BETWEEN THE RAINFALL DISTRIBUTION AND SOIL GROUPS DEVELOPED ON THE ISLAND OF OAHU*

GREAT SOIL GROUP	SOIL FAMILY	NO. OF DRY MONTHS†	NO. OF INTERMEDIATE RAINFALL MONTHS†	NO. OF WET MONTHS†	NO. OF VERY WET MONTHS†
Low humic latosol	Molokai	8	4	0	0
Low humic latosol	Lahaina	6	6	0	0
Low humic latosol	Wahiawa	5	4	0	0
Low humic latosol	Kahana	2	7	3	0
Low humic latosol	Kohala	1	4	8	0
Ferruginous humic latosol	Mahana	9	2	1	0
Ferruginous humic latosol	Naiwa	5	3	4	0
Humic latosol	Kaneohe	1	5	6	0
Humic latosol	Honolua	0	4	8	0
Hydrol humic latosol	Koolau	0	0	8	4
Hydrol humic latosol	Koolau	0	0	3	9

* Mohr's definition of dry and wet months was based on mean monthly rainfall. The data given in this table are based on monthly median rainfall as presented by Halstead and Leopold (1948).

† Dry months, less than 2⅜ inches of rainfall; intermediate rainfall months, 2⅜–4 inches; wet months, 4–8 inches; very wet months, more than 8 inches.

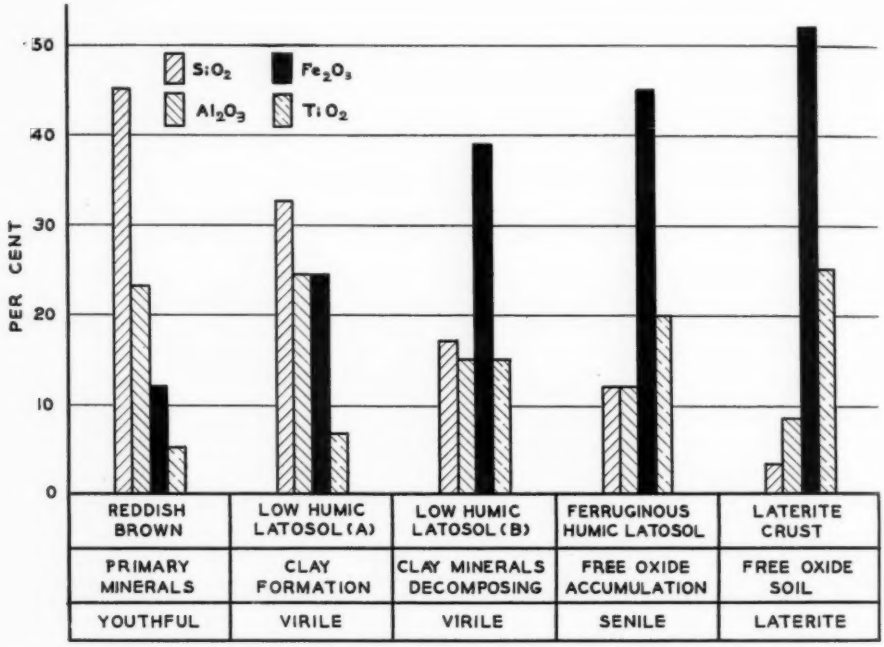

FIG. 2. The influence of the lengthening of the wet season of an alternating wet and dry season climate on the chemical composition of the A horizon of the soil. The wet season increases in this series of soils from left to right. (A) and (B) profiles are two different soils belonging to the low humic latosol.

fact that the soils differ greatly in their chemical composition and physical properties would indicate that the distribution of rainfall must play an important role in the type of weathering which has occurred in the soil.

CHEMICAL COMPOSITION OF SOILS DEVELOPED UNDER A DEFINITE DRY SEASON

The chemical analysis of several soil profiles belonging to the low humic latosol and ferruginous humic latosol to determine their "major" oxide content was made by methods described by Piper (1944). The soils were selected to represent the following successive stages of weathering: (a) the youthful soil containing most of its primary minerals; (b) the peak of clay formation—kaolinization; (c) the stages showing the cessation of clay formation and the increasing oxide formation or clay mineral decomposition; and (d) the final end-product of weathering—the free oxide soil. With the exception of the end-product stage, these stages of soil weathering are found under increasing rainfall. The end-product stage—the oxide soil—exhibits evidence of lateral movement of water through the soil solum. Likewise, the stages of soil weathering exhibit the progressive effect of the shortening of the drought season of these soils.

The results obtained from the analysis of soil samples from the A horizons of the selected soil profiles presenting successive weathering stages are shown graphically in Figure 2. The data show a steady decrease in the silica content of the A horizons with the advancement in the weathering of the soil. Alumina content of the soil increases with the clay formation and decreases rapidly as the clay minerals decompose. The iron and titanium oxides accumulate as the

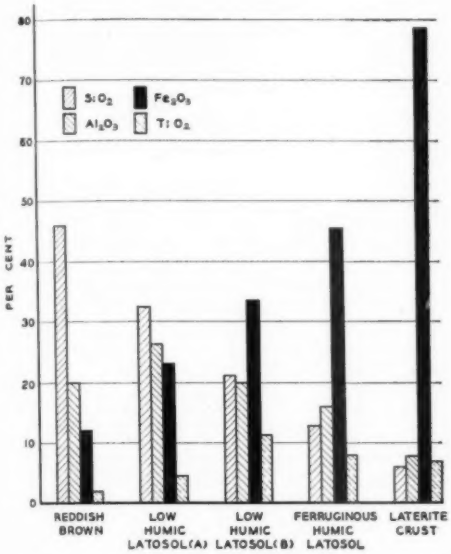

FIG. 3. The influence of the lengthening of the wet season on the chemical composition of the B horizons of the soils shown in Figure 2. (A) and (B) profiles represent two low humic latosols.

soil weathering progresses and in the "laterite crust" they constitute almost 80 per cent of the soil. These oxides are present as two secondary minerals—hematite and anatase.

The data presented graphically in Figure 3 were obtained from the chemical analysis of soil samples representing the B horizons of the soils shown in Figure 2. The silica, alumina, and iron oxide show exactly the same trends as were found for the soils representing the A horizon. Titanium oxide content of the B horizons fails to increase with weathering. Since these soils are very acid, it is probable that the titanium was converted to metatitanic acid and moved upward to the A horizon where it was dehydrated during the dry seasons ultimately to form anatase. The iron oxide of the B horizon of the "laterite crust" exists as hematite and goethite.

The data presented in Figures 2 and 3 represent, in general, a sequence of conditions emphasizing a range in the proportion of dry months to wet months. The range spans from 12 dry months to approximately 3 dry, 3 wet, and 6 intermediate months per year in the ferruginous humic latosol. It is obvious that the effectiveness of an alternating wet and dry season on the rate of soil weathering is governed by the following factors: (a) amount of rainfall during the wet season and (b) the intensity and duration of the dry season. However, the question arises as to the effect of time. Will the soils belonging to the low humic latosol continue to weather until they take on the characteristics of the ferruginous humic latosol? It is reasonable to assume that they will continue to weather toward the end-product, the "laterite crust." The following evidence would support this contention: (a) the increase in area of soils belonging to the ferruginous humic latosol with the geological age of the parent materials and a simultaneous decrease in area of the soils belonging to the low humic latosols. The island of Kauai, geologically the oldest of the major Hawaiian islands, has the greatest area of ferruginous humic latosols, and the low humic latosols show greater advancement in weathering than the same type of soil on younger islands; (b) the decrease in kaolinite content and the increase in iron oxide content in low humic latosols on the older geological parent materials; (c) the occurrence of the "laterite crust" on relatively dry slopes receiving a rainfall comparable to that of the drier low humic latosols on the island of Kauai; and (d) the increase in compaction of the subsoils of the low humic latosols with age, which may favor formation of an impervious subsoil which will in turn develop conditions favorable for the lateral movement of water through those soils occurring on slopes. In the drier regions of the low humic latosols the rainfall will probably never be sufficient in quantity to produce this transformation but in those which have a definite wet season, time will certainly produce ferruginous humic latosol.

CHEMICAL COMPOSITION OF THE SOILS DEVELOPED IN AN ABSENCE OF A DEFINITE DRY PERIOD

The soils belonging to the humic latosol and the hydrol humic latosol have been developed under conditions in which the soil solum rarely dries out. These soils in the Hawaiian Islands are covered with dense cover of ohia, tree ferns, and staghorn fern. The latter two produce an extremely acid forest floor (Sherman, 1947). These soils have been separated in the field on the basis of their clay properties. The clay of the humic latosol can be pressed into a ribbon between one's fingers while that of the hydrol humic latosol will smear. A series of soil profiles representing a sequence of these clays developed under increasing rainfall was selected for analysis. These soils range from a soil profile belonging to an intrazonal group (brown forest) developed under 70 inches of rain per annum to a hydrol humic latosol profile developed under 273 inches of rain per annum; all have developed on parent materials made up of volcanic ash. The data obtained from these analyses are given graphically in Figure 4.

The data presented in Figure 4 show an increase in the alumina content with an increase in rainfall. The silica and iron oxide content appears to decrease with an increase in rainfall. This would suggest that under continuously wet conditions the alumina will become stabilized and iron oxide will become unstable and leach away. Tanada (1944) has identified bauxite and limonite as the minerals representing alumina and iron oxide in these soils. It is likely that as this soil continues to weather, the bauxite will continue to accumulate as a result of the destruction of the kaolinite clay minerals and the removal of silica and iron oxide by leaching. Thus, the end-product of weathering in the very wet tropics will probably be a "bauxite laterite."

DISCUSSION

The author has presented two sequences of soil weathering which are considered to be fun-

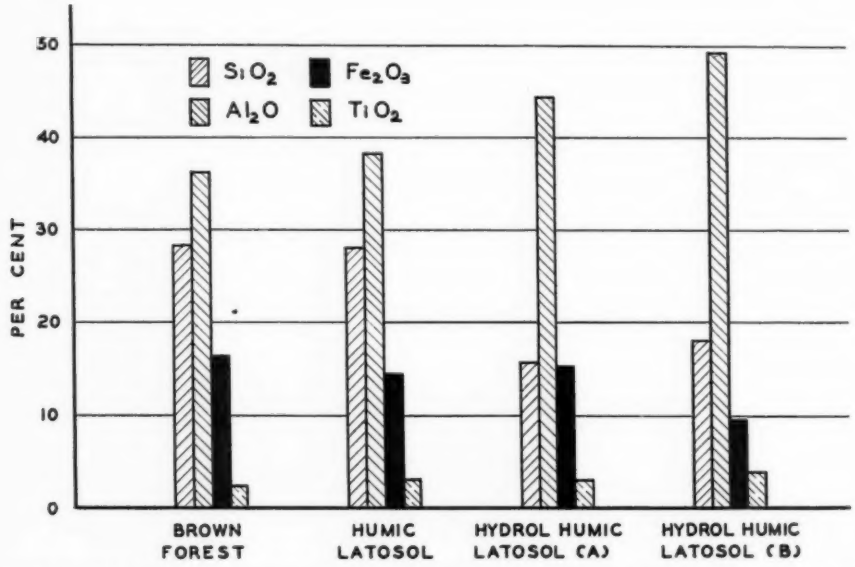

FIG. 4. The influence of an increase in annual rainfall on the chemical composition of soils developed in a continuously wet region.

damental in any interpretation of the soil associations which occur in tropical regions. In this presentation every effort has been made to avoid the complexities in the soil associations due to transition zones, degradation due to shifting climatic conditions or to lowering of the general elevation of volcanic areas, and differences in the composition of the weathered geological materials.

The initial weathering of parent materials is the breakdown of the primary minerals with the formation of secondary clay minerals of the kaolinite type. The rate of decomposition of the kaolinite minerals appears to be closely related to the amount of rainfall under which the soil is formed. Under extremely heavy rainfall the formation of the secondary clay mineral and its subsequent decomposition may be so rapid and transitory as to leave the outline of the original minerals and stratification of the parent materials. The hydrol humic latosols often show the stratification of the original parent material.

The distribution of rainfall plays an important role in the nature of the ultimate end-product of laterization in tropical soils. The stabilization of the iron oxide in soil has resulted from an alternating wet and dry season climate. Under a continuously wet soil profile environment, alumina becomes the stabilized free oxide. The amount of iron remaining in these soils depends on the amount of rainfall and aeration. This would explain to some degree the occurrence of aluminum oxide laterites and iron oxide laterites. The effect of the alternating wet and dry season can be destroyed by the development of a poor internal drainage in the soil solum. If this condition promotes lateral movement of water, as it will on slopes, it will facilitate the development of the iron oxide "laterite crust." If the impervious condition produces a stagnation of the water in the profile, a certain amount of resilication will take place with the removal of the easily reducible iron in the slow leaching of the impervious layer. The result of this condition will be the development of the profile of a very wet soil.

CONCLUSION

The data presented in this paper have emphasized several important fundamental reactions which occur in tropical soil. In the development of tropical soils two weathering actions are taking place: (a) the formation of clay minerals of kaolinite type from the primary minerals, and (b) the decomposition of the clay minerals with the accumulation of free oxides of iron, aluminum, and titanium.

The distribution of the rainfall and proportion of months receiving less than 2⅜ inches of rain (the dry months) and the months receiving more than 4 inches (the wet months), play an important role in the nature of the free oxides which will become stabilized and will accumulate in the soil solum. In evaluating the quantity of rainfall it was found necessary to introduce the number of very wet months (more than 8 inches of rain) in order to differentiate between the humic latosol and hydrol humic latosol which are developed under very wet conditions.

The low humic latosol and the ferruginous humic latosol have developed in a climate having a definite dry season alternating with a wet season of varying length and intensity. The soils developed under this type of season would exhibit the following chemical properties with increased weathering due either to the intensity of the alternating wet or dry conditions or to time of exposure of this type of weathering condition: (a) in the early stages both the kaolinite and alumina content increase and both decrease with further weathering; (b) silica content of the soil decreases with the age of weathering of the soil; (c) the content of iron and titanium oxides in the soil increases with the weathering age of the soil; and (d) the final end-product of weathering under these conditions is a "laterite crust" having a high content of iron and titanium minerals.

The humic latosol and hydrol humic latosol are developed under climates which have no definite dry season. Soils developed under these conditions have the following chemical properties: (a) the rapid decomposition of the clay

minerals to the free oxides; (b) an increase in the alumina content with increase in rainfall; (c) decrease in the content of silica and iron oxide with increase in rainfall; and (d) the ultimate end-product of soil weathering will be an "aluminum oxide laterite," probably a "bauxite laterite."

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Catalogue of the Heterocerous Lepidoptera from French Oceania

PIERRE E. L. VIETTE[1]

INFORMATION ABOUT the lepidopterous fauna of the French territories in the Pacific Ocean is scarce. Aside from the original descriptions, no whole study has been carried out for New Caledonia, the Loyalty Islands, or the New Hebrides. The lepidopterous material collected by F. Sarrasin and J. Roux during their mission (1911) in the first two of these countries has never been studied. The fauna of the other French islands (Society Islands, Marquesas, Archipelago of the Tuamotus, Austral Islands, Gambier Islands) is better known through, first, the material collected by Miss Cheesman during the St. George Expedition (1924–1925) of which the Rhopalocera were studied by Poulton and Riley (1928), the Macroheterocera by Collenette (1928) and Prout (1929), and the "Micros" by Meyrick (1928–1929); and, second, through the material (Micros), collected by the Pacific Entomological Survey, which was studied by Meyrick (1935 *a, b*).

I have covered elsewhere (Lépidoptères Rhopalocères de l'Océanie française. Faune de l'Empire, Editions du Museum, Paris [in press]) the Rhopalocera of these regions, so here I present only a catalogue of the Heterocera. The information both is bibliographical and founded upon the insects present in the collections of the Department of Entomology of the National Museum of Natural History of Paris. Insects were brought to France by people who stayed in those regions (Marie, Joly, Quod, Mrs. Pruvot, Aubert de la Rüe, Risbec, Catala). In spite of this, there is still very much to do, especially for the "Micros" of New Caledonia, Loyalty Islands, and New Hebrides. Many gaps exist; thus all the species described belong to the group Heteroneura Ditrysia; the suborder Homoneura and the Heteroneura Monotrysia are at present unknown. I am therefore unable, for the time being, to study this group in the same way I have the Rhopalocera, which have always been the first Lepidoptera studied in a given area and which are, on the whole, well known. The publication of this catalogue, the first step towards the knowledge of the lepidopterous fauna of these regions, will be, I hope, a first clearing for the lepidopterists who will go to these districts.

Very many species, especially in the New Caledonia, Loyalty Islands, and New Hebrides areas might still be signalized, either as new, or as belonging to the peripheral areas (Australia, New Guinea, etc.).

I have followed the order given by Zerny and Beier (1936) for the order of the families. Within each family or sub-family, the order followed, when it exists, is that of the *Lepidopterorum Catalogus*. For the Noctuidae, Hampson (1903 to 1913) has been taken as a guide.

So as not to lengthen an already very long list of references, the references of the genera are not shown on this list. They can easily be found in S. A. Neave's *Nomenclator Zoologicus*, 4 vol. Zool. Soc. London, London 1939–1940. References to endemic genera are given, however.

Family TINEIDAE

NESOXENA Meyrick (1928*a*: 506)

N. strangulata Meyrick (1928*a*: 507). Archipelago of the Tuamotus: Fakarava ("St. George" Exped.).

TINEA Denis and Shiffermuller

T. monospila Meyrick (1928*a*: 507). Society Islands: Tahiti ("St. George" Exped.).

[1] Department of Entomology, National Museum of Natural History, Paris. Manuscript received July 8, 1948.

T. despecta Meyrick (1919: 274). Marquesas Islands: Hiva Oa (Meyrick, 1935*b*).

T. paralonoma Meyrick (1928*b*: 427). New Hebrides: Efate (Meyrick, l.c.).

CARYOLESTIS Meyrick (1935*a*: 109)

C. praedatrix Meyrick (1935*a*: 110). Society Islands: Tahiti (Meyrick, l.c.). Larva on coconut.

CYNOMASTIX Meyrick (1930: 548)

C. rhothodoxa Meyrick (1930: 548). New Caledonia: Noumea (Cockerell).

Family LYONETIIDAE

OPOGONA Zeller

O. aurisquamosa Butler (1881: 403). Society Islands: Tahiti ("St. George" Exped.). Marquesas Islands (Meyrick, 1928*a*): Eiao, Fatu Hiva, Uahuka (Meyrick, 1935*b*).

O. trissostacta Meyrick (1935*b*: 354). Marquesas Islands: Uahuka, Hiva Oa (Meyrick, l.c.).

PISISTRATA Meyrick (1924: 81)

P. trypheropa Meyrick (1924: 81). Society Islands: Tahiti ("St. George" Exped.). Type from Samoa.

ERECHTHIAS Meyrick

E. zebrina Butler (1881: 403). Society Islands: Raiatea ("St. George" Exped.).

E. flavistriata Walsingham (1907: 716). Marquesas Islands: Fatu Hiva ("St. George" Exped.).

DECADARCHIS Meyrick

D. minuscula Walsingham (1907: 716). Marquesas Islands: Nuka Hiva ("St. George" Exped.).

D. pelotricha Meyrick (1926: 275). Society Islands: Tahiti, Raiatea. Rapa Island ("St. George" Exped.).

D. clistopa Meyrick (1928*a*: 506). Marquesas Islands: Nuka Hiva ("St. George" Exped.).

D. physocapna Meyrick (1928*a*: 506). Marquesas Islands: Hiva Oa ("St. George" Exped.).

D. malthaca Meyrick (1928*b*: 401). New Hebrides: Ambryn (Buxton).

D. capnographa Meyrick (1928*b*: 402). New Hebrides: Tanna (Buxton).

D. platyrrhyncha Meyrick (1928*b*: 402). New Hebrides: Efate (Buxton).

D. simulans Butler (1879: 164). Society Islands: Raiatea. Marquesas Islands: Tahuata ("St. George" Exped.; Meyrick, 1935*b*), Uahuka (Meyrick, 1935*b*).

D. psammaula Meyrick (1921: 459). Society Islands: Tahiti. Austral Islands ("St. George" Exped.).

D. coleosema Meyrick (1935*b*: 354). Marquesas Islands: Hiva Oa (Meyrick, l.c.).

D. persnomicta Meyrick (1935*b*: 355). Marquesas Islands: Eiao.

D. rufimacula Meyrick (1935*b*: 355). Marquesas Islands: Uapou (Meyrick, l.c.).

Family PLUTELLIDAE

TRACHYCENTRA Meyrick (1886: 288)

T. calamias Meyrick (1886: 288). Marquesas Islands: Nuka Hiva ("St. George" Exped.). Type from Tonga and Fiji.

MASTIGOSTOMA Meyrick

M. halithea Meyrick (1927*a*: 330). New Hebrides: Tanna (Buxton and Hopkins).

Family GRACILARIIDAE

EPICEPHALA Meyrick

E. colymbetella Meyrick (1880: 169). Marquesas Islands: Nuka Hiva ("St. George" Exped.).

PARECTOPA Clemens

P. pontificalus Meyrick (1928*a*: 505). Austral Islands: Rurutu ("St. George" Exped.).

GRACILARIA Haworth

G. hilaropis Meyrick (1926: 274). Rapa Island (Meyrick, l.c.).

G. crysidelta Meyrick (1926: 275). Rapa Island (Meyrick, l.c.).

G. scaeodesma Meyrick (1928*b*: 409). New Hebrides (Buxton).

G. deltanthes Meyrick (1935*b*: 354). Marquesas Islands: Uapou (Meyrick, l.c.).

Family COLEOPHORIDAE

AGONOXEMA Meyrick

A. pyrogramma Meyrick (1924: 84). New Hebrides. On the "Sagoutier" (Risbec, 1942).

A. sp. Parasite of the coconut tree in New Caledonia (Risbec, 1942).

Family HYPONOMEUTIDAE

ZELLERIA Stainton

Z. leucostra Meyrick (1928*a*: 504). Marquesas Islands: Nuka Hiva, Tahuata ("St. George" Exped.).

ATTEVA Walker

A. sphaerotrocha Meyrick (1936: 41). New Caledonia (Meyrick, l.c.).

A. mathewi Butler (1887*a*: 414). New Hebrides (Paris Museum, coll. de Joannis).

Family ELACHISTIDAE

PERSICOPTILIA Meyrick (1886: 295)

P. erythrota Meyrick (1886*a*: 295). New Hebrides (Mathew).

Family GLYPHIPTERYGYDAE

IMMA Walker

I. chloroplintha Meyrick (1928*a*: 503). Society Islands: Tahiti ("St. George" Exped.).

I. oxypeselia Meyrick (1928*a*: 503). Society Islands: Raiatea ("St. George" Exped.).

I. semiclara Meyrick (1928*a*: 503). Marquesas Islands: Hiva Oa, Nuka Hiva, Tahuata ("St. George" Exped.).

I. catapsesta Meyrick (1935*b*: 352). Marquesas Islands: Fatu Hiva, Uahuka, Nuka Hiva, Uapou, Hiva Oa (Meyrick, l.c.).

I. fulminatrix Meyrick (1935*b*: 353). Marquesas Islands: Hiva Oa (Meyrick, l.c.).

LOXOTROCHIS Meyrick (1906: 205)

L. sepias Meyrick (1906: 205). New Hebrides: Espiritu Santo (Meyrick, l.c.).

TORTYRA Walker

T. tabularia Meyrick (1912: 37). Loyalty Islands: Lifu (Meyrick, l.c.).

SIMAETHIS Leach

S. chelapsis Meyrick (1928*a*: 504). Marquesas Islands: Hiva Oa ("St. George" Exped. and Meyrick, 1935*b*), Uapou (Meyrick, 1935*b*).

S. orthogona Meyrick (1886*a*: 287). Society Islands: Tahiti, Bora Bora ("St. George" Exped.). Type from New Guinea.

S. chalcotoxa Meyrick (1886*a*: 287). Society Islands: Bora Bora ("St. George" Exped.). Type from Tonga and Fiji.

Family SCHRECKENSTEINIIDAE
(= Heliodinidae)

STATHMOPODA Stainton

S. cryptophaea Meyrick (1922: 585). Society Islands: Tahiti (Paris Museum, coll. de Joannis).

S. mesocrossa Meyrick (1927*a*: 379). New Hebrides: Efate (Buxton).

S. electrantha Meyrick (1927*a*: 377). New Hebrides: Tanna (Buxton and Hopkins).

PACHYRABDA Meyrick

P. euphanopis Meyrick (1927*a*: 377). New Hebrides: Espiritu Santo (Buxton).

LISSOCNEMITIS Meyrick (1935*b*: 352)

L. argolyca Meyrick (1935*b*: 352). Marquesas Islands: Hiva Oa (Meyrick, l.c.).

Family COPROMORPHIDAE

DRYANASSA Meyrick (1936: 40)

D. erebactis Meyrick (1936: 40). Society Islands: Tahiti (Meyrick, l.c.).

Family ORNEODIDAE

ORNEODES Latreille

O. pselioxantha Meyrick (1928*a*: 502). Archipelago of the Tuamotus: Fakarava ("St. George" Exped.).

Family CARPOSINIDAE

CARPOSINA Herrich Schäffer

C. stationaria Meyrick (1928*b*: 403). New Hebrides: Tanna (Buxton).

C. asbolopis Meyrick (1928*b*: 403). New Hebrides: Tontouta (Buxton).

MERIDARCHIS Zeller

M. pelograpta Meyrick (1928*a*: 502). Austral Islands: Rurutu ("St. George" Exped.).

Family OECOPHORIDAE

BATHRAULA Meyrick

B. simulatella Walker (1864*b*: 747). Society Islands: Tahiti (Gaede, 1938: 91).

Family COSMOPTERYGIDAE

COSMOPTERYX Hübner (1825: 274)

C. aphranassa Meyrick (1926: 274). Rapa Islands (Meyrick, l.c.).

C. flavofasciata Wollaston (1879: 438). Society Islands ("St. George" Exped.).

C. melanarches Meyrick 1928*a*: 497). Society Islands: Raiatea (Meyrick, l.c.).

PYRODERCES Herrich Schäffer

P. incertulella Walker (1864*b*: 748). Austral Islands: Rurutu ("St. George" Exped.). Risbec (1942: 19) names a *Pyroderces* but does not give the name of the species; a parasite of cotton in New Caledonia.

P. syngalactis Meyrick (1928*b*: 382). New Hebrides: Efate, Espiritu Santo (Buxton).

P. lunulifera Meyrick (1935*b*: 347). Marquesas Islands: Hiva Oa, Eiao, Tahuata, Fatu Hiva, Uapou (Meyrick, l.c.).

PERSICOPTILA Meyrick (1886: 295)

Pe. erythrota Meyrick (1886*a*: 295). New Hebrides (Mathew).

Pe. heroica Meyrick (1928*b*: 391). New Hebrides: Tanna, Ambryn, Efate (Buxton).

BATRACHEDRA Stainton

B. arenosella Walker (1864*b*: 857). New Hebrides. Parasite of cotton.

HEDROXENA Meyrick (1924: 92)

H. barbara Meyrick (1924: 92). New Hebrides: Espiritu Santo (Simmonds).

LABDIA Walker

L. clodiana Meyrick (1927*a*: 384). New Hebrides: Efate, Ambryn (Buxton).

L. leucoxantha Meyrick (1927*b*: 87). Marquesas Islands: Uapou, Hiva Oa (Meyrick, 1935*b*). Type from Samoa.

L. saliens Meyrick (1928*b*: 384). New Hebrides: Efate, Ambryn (Buxton).

L. crocopa Meyrick (1928*b*: 385). New Hebrides: Tanna (Buxton).

L. torodoxa Meyrick (1928*b*: 386). New Hebrides: Espiritu Santo, Ambryn, Efate (Buxton).

L. cedrinopa Meyrick (1928*b*: 386). New Hebrides: Efate (Buxton).

L. semnolitha Meyrick (1928*b*: 386). New Hebrides: Espiritu Santo (Buxton).

TRISSODORIS Meyrick

T. honorarielle Walsingham (1907: 515, XV, 21). Marquesas Islands: Fatu Hiva, Hiva Oa (Meyrick, 1935*b*). Also in Samoa.

STAGMATOPHORA Herrich Schäffer

S. spintheropa Meyrick (1935*b*: 348). Marquesas Islands: Uapou (Meyrick, l.c.).

LIMNAECIA Stainton

L. microglypta Meyrick (1928*b*: 393). New Hebrides: Efate, Espiritu Santo (Buxton).

L. astathopis Meyrick (1935*b*: 393). Marquesas Islands: Hiva Oa (Meyrick, l.c.).

ASYMPHORODES Meyrick (1928*b*: 498)

A. perfuga Meyrick (1926: 274). Rapa Island, with the name *Ulochora perfuga.*

A. coesyrias Meyrick (1928*a*: 498). Marquesas Islands: Tahuata, Hiva Oa ("St. George" Exped.; Meyrick, 1935*b*). Nuka Hiva ("St. George" Exped.).

A. valligera Meyrick (1928*a*: 498). Marquesas Islands: Hiva Oa ("St. George" Exped.).

A. plectographa Meyrick (1928*a*: 498). Marquesas Islands: Hiva Oa ("St. George" Exped.).

A. sphenocopa Meyrick (1928*a*: 499). Marquesas Islands: Nuka Hiva, Hiva Oa, Fatu Hiva, Tahuata ("St. George" Exped.).

A. leucoterma Meyrick (1928*a*: 499). Marquesas Islands: Hiva Oa ("St. George" Exped.).

A. circopis Meyrick (1928*a*: 499). Marquesas Islands: Hiva Oa ("St. George" Exped.).

A. nephocirca Meyrick (1928*a*: 500). Marquesas Islands: Hiva Oa ("St. George" Exped.).

A. interstincta Meyrick (1928*a*: 500). Archipelago of the Tuamotus: Fakarava ("St. George" Exped.).

A. polluta Meyrick (1928*a*: 500). Marquesas Islands: Hiva Oa ("St. George" Exped.).

A. cirsodes Meyrick (1928*a*: 500). Marquesas Islands: Hiva Oa ("St. George" Exped.).

A. myronota Meyrick (1928*a*: 500). Marquesas Islands: Hiva Oa ("St. George" Exped.).

A. porphyrarcha Meyrick (1928*a*: 501). Marquesas Islands: Hiva Oa ("St. George" Exped.).

A. monoxesta Meyrick (1928*a*: 501). Society Islands: Tahiti ("St. George" Exped.).

A. chalcozona Meyrick (1935*a*: 109). Society Islands: Tahiti.

A. admiranda Meyrick (1935*b*: 349). Marquesas Islands: Uapou.

A. oculisignis Meyrick (1935*b*: 349). Marquesas Islands: Hiva Oa.

A. ingravescens Meyrick (1935*b*: 350). Marquesas Islands: Hiva Oa.

A. xanthostola Meyrick (1935*b*: 350). Marquesas Islands: Hiva Oa, Uapou.

A. xestophanes Meyrick (1935*b*: 351). Marquesas Islands: Hiva Oa.

A. ergodes Meyrick (1935*b*: 351). Marquesas Islands: Hiva Oa.

A. acrophrictis Meyrick (1935*b*: 351). Marquesas Islands: Uapou.

A. balanotis Meyrick (1935*b*: 351). Marquesas Islands: Eiao, Hiva Oa.

A. holoporphyra Meyrick (1935*b*: 352). Marquesas Islands: Hiva Oa.

MICROZESTIS Meyrick (1928*a*: 501)

M. inelegans Meyrick (1928*a*: 502). Marquesas Islands: Tahuata, Hiva Oa ("St. George" Exped.).

Family GELECHIIDAE

ANARSIA Zeller

A. anthracaula Meyrick (1929*b*: 512); Gaede (1937: 401). New Hebrides: Tanna (Aubert de la Rüe), Efate (Buxton).

PLATYEDRA Meyrick

P. gossypiella Saunders (1843: 284); Gaede (1937: 231). New Caledonia (Risbec, 1942). Society Islands: Raiatea ("St. George" Exped.).

GNORIMOSCHEMA Busck

G. operculella Zeller (1873: 262, III, 17); Gaede (1937: 277). New Caledonia (Risbec, 1942; Barrau); on cotton and tobacco. Marquesas Islands: Hiva Oa ("St. George" Exped.).

DICHOMERIS Hübner

D. resignata Meyrick (1929*b*: 510); Gaede (1937: 552). New Hebrides: Espiritu Santo (Buxton).

STOEBERHINUS Butler (1881: 402)

S. testacea Butler (1881: 402); Gaede (1937: 552). New Hebrides. Marquesas Islands: Nuka Hiva, Hiva Oa, Fatu Hiva, Tahuata. Society Islands: Tahiti, Raiatea. Austral Islands: Rurutu. Rapa Island. Archipelago of the Tuamotus: Napuka ("St. George" Exped.). Type from Hawaii. Also in Fiji and Samoa.

AUTOSTICHA Meyrick (1886: 281)

A. pelodes Meyrick (1883: 34); Gaede (1937: 555). New Hebrides. Marquesas Islands: Nuka Hiva, Tahuata. Type from Hawaii.

Family EUCOSMIDAE

LOBESIA Guénée

L. peplotoma Meyrick (1928*b*: 442). New Hebrides: Efate (Buxton).

POLYCHROSIS Ragonot

P. orthomorpha Meyrick (1928*b*: 443). New Hebrides: Espiritu Santo, Efate (Buxton).

CROCIDOSEMA Zeller

C. plebeiana Zeller (1847: 722). Society

Islands: Tahiti, Raiatea. Marquesas Islands: Nuka Hiva, Hiva Oa, Tahuata. Rapa Island ("St. George" Exped.). Larva on Malvaceae.

BACTRA Stephens

B. truculenta Meyrick (1909: 586). New Caledonia: Noumea (Catala, Barrau). Larva on *Cyperus rotundus*. Also in Fiji and Hawaii, introduced.

B. litigatrix Meyrick (1928*a*: 495). Society Islands: Tahiti ("St. George" Exped.).

EUCOSMA Hübner

E. agriochlora Meyrick (1928*a*: 495). Marquesas Islands: Nuka Hiva ("St. George" Exped.).

E. chaomorpha Meyrick (1928*a*: 495). Marquesas Islands: Nuka Hiva, Hiva Oa ("St. George" Exped.).

ACROCLITA Lederer

Ac. physalodes Meyrick (1910*a*: 368). Austral Islands: Rurutu ("St. George" Exped.).

Ac. eocnephaea Meyrick (1935*b*: 345). Marquesas Islands: Hiva Oa (l.c.).

ARGYROPLOCE Hübner

A. rhynchias Meyrick (1905: 586). Marquesas Islands: Hiva Oa, Tahuata. Society Islands: Tahiti, Raiatea. Austral Islands: Rurutu ("St. George" Exped.).

A. aprobola Meyrick (1926: 273). Rapa Island.

A. eumenica Meyrick (1928*a*: 496). Marquesas Islands: Hiva Oa ("St. George" Exped.).

A. isodoxa Meyrick (1928*b*: 444). New Hebrides: Tanna (Buxton).

SPILONOTA Stephens

S. thyellopis Meyrick (1926: 273). Rapa Island.

S. dilacerata Meyrick (1928*a*: 494). Austral Islands: Rurutu ("St. George" Exped.).

S. holotephras Meyrick (1924: 67). Marquesas Islands: Nuka Hiva, Hiva Oa, Tahuata ("St. George" Exped.). Type from Fiji.

Family TORTRICIDAE

NESOSCOPA Meyrick (1926: 271)

N. exsors Meyrick (1926: 74). Rapa Island.

DICHELOPA Lower

D. honoranda Meyrick (1926: 272). Rapa Island.

D. sericopis Meyrick (1926: 272). Rapa Island.

D. deltozancla Meyrick (1926: 272). Rapa Island.

D. ceramocausta Meyrick (1926: 272). Rapa Island (Meyrick, l.c., and "St. George" Exped.).

D. iochorda Meyrick (1926: 273). Rapa Island.

D. exulcerata Meyrick (1926: 273). Rapa Island (Meyrick, l.c., and "St. George" Exped.).

D. pachydmeta Meyrick (1928*a*: 493). Marquesas Islands: Hiva Oa ("St. George" Exped.).

D. argoschistes Meyrick (1928*a*: 493). Society Islands: Tahiti ("St. George" Exped.).

D. fulvistrigata Meyrick (1928*a*: 494). Society Islands: Tahiti ("St. George" Exped.).

D. peropaca Meyrick (1928*a*: 494). Marquesas Islands: Nuka Hiva ("St. George" Exped.).

D. choleranthes Meyrick (1928*a*: 493). Marquesas Islands: Hiva Oa ("St. George" Exped.).

D. dryomorpha Meyrick (1928*a*: 492). Marquesas Islands: Tahuata ("St. George" Exped.).

D. praestrigata Meyrick (1928*a*: 492). Marquesas Islands: Hiva Oa ("St. George" Exped.).

D. harmodes Meyrick (1928*a*: 494). Marquesas Islands: Hiva Oa ("St. George" Exped.).

D. argosphena Meyrick (1935*b*: 343). Marquesas Islands: Hiva Oa.

D. pyrsogramma Meyrick (1935*b*: 343). Marquesas Islands: Nuka Hiva.

D. orthiostyla Meyrick (1935*b*: 343). Marquesas Islands: Hiva Oa.

D. porphyrophanes Meyrick (1935*b*: 344). Marquesas Islands: Uapou, Hiva Oa.

D. phalaranthes Meyrick (1935*b*: 344). Marquesas Islands: Hiva Oa.

D. cirrhodoris Meyrick (1935*b*: 344). Marquesas Islands: Hiva Oa.

D. castanopis Meyrick (1935*b*: 345). Marquesas Islands: Hiva Oa, Uapou.

XENOTHICTIS Meyrick (1910: 279)

X. paragona Meyrick (1910*b*: 280). Loyalty Islands: Lifu.

X. semiota Meyrick (1910*b*: 280). Loyalty Islands: Lifu.

Family LIMACODIDAE

MIRESA Walker

M. alma Druce (1898: 215). New Caledonia.

M. sobrina Druce (1898: 214). New Caledonia.

Family PYRALIDIDAE

Subfamily PHYCITINAE

ASPITHRA Ragonot

A. maculicostella Ragonot (1888: 37). Marquesas Islands: Nuka Hiva, Hiva Oa, Tahuata.

A. chrysura Meyrick (1929*a*: 158). Marquesas Islands: Nuka Hiva, Hiva Oa ("St. George" Exped.).

A. dryinandra Meyrick (1929*a*: 157). Marquesas Islands: Hiva Oa ("St. George" Exped.).

A. denticornis Meyrick (1929*a*: 156). Marquesas Islands: Hiva Oa, Fatu Hiva ("St. George" Exped.).

PHYCITA Curtis

P. orthoclina Meyrick (1929*a*: 158). Marquesas Islands: Hiva Oa, Nuka Hiva, Tahuata ("St. George" Exped.).

ETIELLA Zeller

E. drososcia Meyrick (1929*a*: 158). Society Islands: Tahiti ("St. George" Exped.).

HOMOEOSOMA Curtis

H. inexplorata Meyrick (1929*a*: 158). Society Islands: Tahiti. Austral Islands: Rurutu. Rapa Island ("St. George" Exped.).

CTENOMERISTIS Meyrick (1929*a*: 159)

Ct. ochrodepta Meyrick (1929*a*: 159). Marquesas Islands: Hiva Oa, Nuka Hiva ("St. George" Exped.).

CATEREMMA Meyrick

C. albicostalis Walker (1865: 1258). Marquesas Islands: Nuka Hiva ("St. George" Exped.).

C. halmophila Meyrick (1929*a*: 159). Marquesas Islands: Hiva Oa, Tahuata, Fatu Hiva ("St. George" Exped.).

ACROBASIS Zeller

A. ptilophanes Meyrick (1929*a*: 160). Society Islands: Tahiti ("St. George" Exped.).

EURHODOPE Hübner

E. ardescens Meyrick (1929*a*: 160). Society Islands: Tahiti, Raiatea. Austral Islands: Rurutu ("St. George" Exped.).

Subfamily SCOPARIINAE

SCOPARIA Haworth

S. chrysomicta Meyrick (1929*a*: 166); Klima (1937: 43). Marquesas Islands: Hiva Oa ("St. George" Exped.).

S. chrysopetra Meyrick (1929*a*: 169); Klima (1937: 43). Society Islands: Tahiti ("St. George" Exped.).

S. citrocosma Meyrick (1929*a*: 166); Klima (1937: 43). Marquesas Islands: Hiva Oa ("St. George" Exped.).

S. clerica Meyrick (1929*a*: 167); Klima (1937: 43). Marquesas Islands: Hiva Oa ("St. George" Exped.).

S. commercialis Meyrick (1929*a*: 167); Klima (1937: 43). Marquesas Islands: Hiva Oa ("St. George" Exped.).

S. officialis Meyrick (1929*a*: 168); Klima (1937: 44). Marquesas Islands: Hiva Oa ("St. George" Exped.).

S. opostactis Meyrick (1929*a*: 168); Klima (1937: 44). Marquesas Islands: Fatu Hiva ("St. George" Exped.).

S. philorphna Meyrick (1929*a*: 168); Klima (1937: 45). Society Islands: Tahiti ("St. George" Exped.).

S. spectacularis Meyrick (1929*a*: 167); Klima (1937: 45). Marquesas Islands: Hiva Oa ("St. George" Exped.).

DARYSCOPA Meyrick

D. polysemalis Hampson (1897: 239); Klima (1937: 56). Loyalty Islands: Lifu.

Subfamily NYMPHULINAE

CATACLYSTA Hübner

C. blandialis Walker (1859: 448); Klima (1937: 96). New Caledonia: Voh (Catala).

DRACAENURA Meyrick (1886*a*: 227)

D. myota Meyrick (1886*a*: 230); Klima (1937: 135). New Hebrides. Also in Fiji.

D. leucoprocta Hampson (1897: 193); Klima (1937: 135). New Hebrides (Mathew).

D. cincticorpus Hampson (1897: 194); Klima (1937: 136). Loyalty Islands.

PHYTHAGOREA Meyrick (1929*a*: 162)

P. categorica Meyrick (1929*a*: 162); Klima (1937: 136). Society Islands: Tahiti ("St. George" Exped.).

AULACODES Guénée

A. secutalis Walker (1865: 1291); Klima (1937: 143). New Hebrides.

A. eupselias Meyrick (1929*a*: 161); Klima (1937: 143). Marquesas Islands: Tahuata ("St. George" Exped.).

DECTICOGASTER Snellen

D. biannulalis Walker (1865: 1439); Klima (1937: 146). New Hebrides.

D. vibrata Meyrick (1929*a*: 161); Klima (1937: 148). Marquesas Islands: Hiva Oa ("St. George" Exped.).

BRADINA Lederer

B. rectiferalis Walker (1862*a*: 126); Klima (1937: 154). New Caledonia (Walker): Voh (Catala). Loyalty Islands (Paris Museum, coll. Ragonot). New Hebrides.

B. antisema Meyrick (1886*a*: 263); Klima (1937: 155). New Hebrides.

B. perlucidalis Hampson (1897: 201); Klima (1937: 155). Marquesas Islands: Taou Ata (J. J. Walker).

B. tormentifera Meyrick (1929*a*: 161); Klima (1937: 156). Marquesas Islands ("St. George" Exped.).

PILETOCERA Lederer

P. signiferalis Wallengren (1860: 175); Klima (1937: 175). Marquesas Islands. Society Islands: Tahiti.

P. ochrosema Meyrick (1886*a*: 247); Klima (1937: 176). New Hebrides. Also in Fiji.

Subfamily PYRAUSTINAE

REHIMENA Walker

R. cissiphora Turner (1908: 88); Klima (1939: 29). New Hebrides.

HYMENIA Hübner

H. recurvalis Fabricius (1775: 644); Klima (1939: 31) (=*Zinckenia fascialis* Cr.). New Caledonia: Noumea (Catala). New Hebrides. Society Islands: Tahiti. Marquesas Islands: Tahuata. Rapa Island ("St. George" Exped.).

EURRHYPARODES Snellen

Eu. bracteolalis Zeller (1852*a*: 30); Klima (1939: 36). New Hebrides.

Eu. tricoloralis Zeller (1852*a*: 31); Klima (1939: 425). Austral Islands: Rurutu ("St. George" Exped.).

ERCTA Walker

E. ornatalis Duponchel (1831: 207); Hampson (1898: 37); Klima (1939: 57). New Hebrides. Society Islands: Tahiti.

E. chalybitis Meyrick (1885: 444); Hampson (1898: 637); Klima (1939: 59). New Hebrides.

CNAPHALOCROCIS Lederer

C. medinalis Guénée (1854: 201); Hampson (1898: 638); Klima (1939: 61). New Caledonia. New Hebrides.

MARASMIA Lederer

M. venilialis Walker (1859: 373); Hampson (1898: 639); Klima (1939: 65). Society Islands: Tahiti, Bora Bora. Marquesas Islands: Hiva Oa, Fatu Hiva, Nuka Hiva, Tahuata ("St. George" Exped.).

M. trapezalis Guénée (1854: 200); Hampson (1898: 639); Klima (1939: 65). Society Islands: Tahiti, Bora Bora, Raiatea. Austral Islands: Rurutu ("St. George" Exped.).

M. hemicrossa Meyrick (1886*a*: 217); Hampson (1898: 639); Klima (1939: 65). Society Islands: Tahiti, Moorea. Rapa Island.

SYNGAMIA Guénée

S. floridalis Zeller (1852*a*: 60); Hampson (1898: 644); Klima (1939: 71). New Hebrides (Hampson, l.c.). Society Islands: Tahiti (Meyrick, 1886*a*).

S. calidalis Guénée (1854: 294); Hampson (1898: 644); Klima (1939: 71). New Hebrides.

CAPRINIA Walker

C. mysteris Meyrick (1886*a*: 233); Klima (1939: 110). New Hebrides.

LAMPROSEMA Hübner

L. diemenalis Guénée (1854: 203); Hampson (1898: 699); Klima (1939: 162). New Hebrides (Hampson, l.c.). Society Islands: Tahiti, Bora Bora, Raiatea. Austral Islands: Rurutu ("St. George" Exped.).

L. octasema Meyrick (1886*a*: 259); Hampson (1898: 703); Klima (1939: 162). New Hebrides (Hampson, l.c.). New Caledonia (Catala). Parasite of banana. Also in Fiji.

SYLEPTA Hübner

S. derogata Fabricius (1775: 641); Klima (1939: 193). New Hebrides. Also in Fiji.

LYGROPIA Lederer

L. erixantha Meyrick (1886*a*: 258); Hampson (1898: 728); Klima (1939: 250). New Hebrides.

DIAPHANIA Hübner

D. indica Saunders (1851: 163); Hampson (1898: 738); Klima (1939: 239). New Caledonia: Voh (Catala). Society Islands: Tahiti (Hampson, l.c.; Vesco). Marquesas Islands: Taio Hae (Delmas).

D. glauculalis Guénée (1854: 306); Hampson (1898: 741); Klima (1939: 243). New Hebrides.

D. actorionalis Walker (1859: 498); Hampson (1898: 742); Klima (1939: 245). New Hebrides.

D. laticostalis Guénée (1854: 303); Hampson (1898: 732); Klima (1939: 247). New Hebrides.

D. incurvata Warren (1896*b*: 116); Hampson (1898: 730); Klima (1939: 252). Loyalty Islands: Lifu.

D. deliciosa Butler (1887*b*: 114); Hampson (1898: 742); Klima (1939: 257). New Hebrides. New Caledonia (Paris Museum, coll. Ragonot).

D. excelsalis Walker (1865: 1360); Hampson (1898: 742); Klima (1939: 257). Loyalty Islands (Paris Museum, coll. Ragonot): Lifu (Hampson, l.c.).

D. eurytusalis Walker (1859: 503); Hampson (1898: 743); Klima (1939: 259). Loyalty Islands (Hampson, l.c.; Paris Museum, coll. Ragonot).

D. stolalis Guénée (1854: 293, III, 11); Hampson (1898: 744); Klima (1939: 260). New Hebrides.

D. oceanitis Meyrick (1886*a*: 222); Hampson (1898: 741); Klima (1939: 269). New Hebrides.

D. talangalis Hampson (1898: 761, L, 15); Klima (1939: 271). Loyalty Islands: Lifu.

D. multilinealis Kenrick (1907: 83, IV, 173); Klima (1939: 273). New Hebrides. Also in Fiji and Samoa.

D. euthalassa Meyrick (1935*b*: 338); Klima (1939: 272). Marquesas Islands: Hiva Oa.

D. phormingopa Meyrick (1935*b*: 339); Klima (1939: 273). Marquesas Islands: Hiva Oa.

D. uranoptris Meyrick (1929*a*: 163); Klima (1939: 273). Society Islands: Tahiti ("St. George" Exped.).

D. psammocyma Meyrick (1929*a*: 163); Klima (1939: 273). Society Islands: Tahiti ("St. George" Exped.).

CHRYSOPHYLLIS Meyrick (1935*b*: 337)

Ch. lucivaga Meyrick (1935*b*: 338); Klima (1939: 287). Marquesas Islands: Hiva Oa.

TALANGA Moore

T. sexpunctalis Moore (1877: 616, LX, 12); Klima (1939: 288). New Caledonia: Baraoua (Catala). New Hebrides.

OEBIA Hübner

O. undalis Fabricius (1794: 226); Hampson (1898: 760, 87); Klima (1939: 309). In every island of the Pacific (Klima, l.c.).

O. cleoropa Meyrick (1935*b*: 340); Klima (1939: 312). Marquesas Islands: Hiva Oa.

EPIPAGIS Hübner

E. cancellalis Zeller (1852*a*: 34); Klima (1939: 314). New Caledonia: Baraoua (Catala).

ARCHERNIS Meyrick

A. subfulvalis Klima (1939: 325). Society Islands.

TERASTIA Guénée

T. meticulosalis Guénée (1854: 212); Klima (1939: 326). New Hebrides.

ISCHNURGES Lederer

I. octoguttalis Felder and Rogenhofer (1874: 4); Hampson (1898: 179); Klima (1939: 351). Loyalty Islands. Society Islands: Tahiti.

MARUCA Walker

M. testulalis Hübner and Geyer (1832: 12, fig. 629). New Caledonia: Voh (Catala). Marquesas Islands: Hiva Oa, Tahuata, Nuka Hiva, Fatu Hiva. Society Islands: Tahiti, Moorea, Raiatea. Austral Islands: Rurutu ("St. George" Exped.).

DIASEMA Hübner

D. ramburialis Duponchel* (1831: 343). Society Islands: Tahiti. Austral Islands: Rurutu ("St. George" Exped.).

PACHYZANCLA Meyrick

P. stultalis Walker (1859: 669). Marquesas Islands: Hiva Oa ("St. George" Exped.).

PSARA Snellen

Ps. licarsisalis Walker (1859: 686). Society Islands: Tahiti, Raiatea. Austral Islands: Rurutu. Rapa Island ("St. George" Exped.).

MECYNA Doubleday

M. aureolalis Lederer (1863: 473). Society Islands: Tahiti ("St. George" Exped.).

CALAMOCHROUS Lederer

C. thermochra Meyrick (1929*a*: 165). Society Islands: Tahiti ("St. George" Exped.).

IDIOBLASTA Warren

I. lacteata Warren (1891: 62). Marquesas Islands: Nuka Hiva ("St. George" Exped.).

I. straminata Warren (1891: 62). Marquesas Islands: Hiva Oa ("St. George" Exped.).

ISOCENTRIS Meyrick

Is. illectalis Walker (1859: 362). Rapa Island ("St. George" Exped.).

PYRAUSTA Schrank

P. phthorosticata Meyrick (1929*a*: 166). Marquesas Islands: Hiva Oa ("St. George" Exped.).

Subfamily PYRALINAE

ENDOTRICHA Zeller

E. mesenterialis Walker (1859: 285). Society Islands: Tahiti. Austral Islands: Rurutu ("St. George" Exped.).

HERCULIA Walker

H. repetita Butler (1887*b*: 115). Society Islands: Tahiti ("St. George" Exped.).

Subfamily GALLERIINAE

MELIPHORA Guénée

M. grisella Fabricius (1794: 289). Society Islands: Tahiti ("St. George" Exped.).

APHOMIA Hübner

A. sociella Linné (1758: 534). New Caledonia: Baraoua (Catala).

TIRATHABA Walker

T. rufivena Walker (1866: 1956). New Caledonia. New Hebrides. Parasite of the cotton tree (Risbec, 1942).

COLEONEURA Ragonot

C. trichogramma Meyrick (1886*a*: 273). New Hebrides (Risbec, 1942). Type from Fiji.

Family PTEROPHORIDAE

SPHENARCHES Meyrick

S. caffer Zeller (1852*b*: 348); Meyrick (1913: 5). New Hebrides.

ALUCITA Linné

A. aptalis Walker (1864*b*: 950); Meyrick (1913: 17). New Hebrides.

MARASMARCHA Meyrick

M. pumilio Zeller (1873: 324); Meyrick (1913: 28). Marquesas Islands: Nuka Hiva, Hiva Oa, Tahuata, Fatu Hiva. Society Islands: Tahiti. Austral Islands: Rurutu ("St. George" Exped.).

Family THYRIDIDAE

HYPOLAMPRUS Hampson

H. squalida Warren (1908: 337); Dalla Torre (1924: 16). Loyalty Islands: Lifu.

Family SPHINGIDAE

Subfamily ACHERONTIINAE

HERSE Oken

H. convolvuli Linné (1758: 490); Wagner (1913: 7). Society Islands: Tahiti.

H. fasciatus Rothschild (1894: 94); Wagner (1913: 5). Loyalty Islands: Lifu.

PSILIGRAMMA Rothschild and Jordan

P. menephron Cramer (1780: 164); Wagner (1913: 25).

subsp. **lifuense** Rothschild (1894: 90). New Caledonia (Wagner): Noumea (Quod). New Hebrides (Mrs. Pruvot). Loyalty Islands: Lifu (Rothschild).

Subfamily SESIINAE

CEPHONODES Hübner

C. janus Miskin (1891: 6); Wagner (1914: 216).

subsp. **simplex** Rothschild (1894: 86). Loyalty Islands: Lifu.

C. lifuensis Rothschild (1894: 66). New Caledonia: Noumea (Quod). Loyalty Islands: Lifu.

C. novebudensis Clark (1927: 106). New Hebrides.

Subfamily PHILAMPELINAE

CHROMIS Hübner

Ch. erotus Cramer (1777: 12, CIV, B); Wagner (1915: 232). New Caledonia (Marie): Noumea (Quod, Risbec). New Hebrides (Mrs. Pruvot): Vaté, Port Vila (Risbec). Society Islands (J. J. Walker, 1883; Paris Museum, coll. de Joannis; "St. George" Exped.): Bora Bora ("St. George" Exped.). Marquesas Islands: Taiohae (Delmas), Hiva Oa, Nuka Hiva, Tahuata ("St. George" Exped.; Collenette, 1935). Archipelago of the Tuamotus: Napuka. Austral Islands: Rurutu ("St. George" Exped.).

DEILEPHILA Laspeyres

D. placida Walker (1856*b*: 186); Wagner (1915: 239).

subsp. **torenia** Druce (1882: 16). Loyalty Islands: Lifu. New Hebrides: Espiritu Santo (Risbec).

MACROGLOSSUM Scopoli

M. hirundo Boisduval (1832: 184); Wagner (1915: 296).

subsp. **typ.** Society Islands: Tahiti (Dumont d'Urville in coll. Paris Museum; Challier; "St. George" Exped.).

subsp. **confluens** Rothschild and Jordan (1906: 407). New Hebrides (Wagner): Vaté, Port Vila (Risbec).

subsp. **lifuensis** Rothschild (1894: 67). New Caledonia. Loyalty Islands: Lifu (Wagner).

M. corythus Walker (1856*b*: 92); Wagner (1915: 299).

subsp. **novebudensis** Clark (1926: 54). New Hebrides.

subsp. **fuscicauda** Rothschild and Jordan (1903: 663). Loyalty Islands: Lifu.

M. moluccensis Rothschild (1894: 67). Loyalty Islands: Lifu. Might really be *M. corythus* Wlk.

M. marquesanum Collenette (1935: 209). Marquesas Islands: Hiva Oa (Le Bronnec).

HIPPOTION Hübner

H. velox Fabricius (1793: 378); Wagner 1919: 376) (=*Panacra griseola* Rothschild =*P. lifuensis* Rothsch.=*P. rosea* Rothsch.). New Caledonia (Millot; Paris Museum, coll. de Joannis). Loyalty Islands: Lifu (Rothschild).

H. celerio Linné (1758: 491); Wagner (1919: 377). New Caledonia: Noumea (Quod), Paita (Antonino), Western Coast (Risbec). New Hebrides: Vaté, Port Vila; Mallicolo (Risbec). Society Islands: Tahiti (J. J. Walker, 1883).

THERETRA Hübner

T. nessus Drury (1773: 46); Wagner (1919: 388). New Caledonia: Noumea (Quod).

T. clotho Drury (1773: 48); Wagner (1919: 390). Loyalty Islands: Lifu.

T. silherensis Walker (1856*b*: 143); Wagner (1919: 401). New Hebrides (Mrs. Pruvot).

Family GEOMETRIDAE

Subfamily BOARMINAE

CLEORA Curtis

C. hemiopa Prout (1928: 160). New Hebrides (Prout, l.c.).

C. decisaria Walker (1866: 1589).

subsp. **quirosi** Prout (1929*b*: 207). New Hebrides ("St. George" Exped.).

subsp. **ecdees** Prout (1929*b*: 207). Loyalty Islands: Lifu (Tring Museum).

C. psychastis Meyrick (1886*a*: 211). New Hebrides.

C. immemorata Walker (1862*b*: 1540). Loyalty Islands: Lifu (Butler, 1877). New Caledonia.

C. collenettei Prout (1929*c*: 255). Marquesas Islands: Hiva Oa, Fatu Hiva, Tahuata, Nuka Hiva ("St. George" Exped.).

C. esoterica Prout (1929*c*: 255). Marquesas Islands: Hiva Oa ("St. George" Exped.).

C. myrmidonaria Guénée (1857*a*: 271). Society Islands: Tahiti ("St. George" Exped.).

C. cheesmanae Prout (1929*b*: 217). New Hebrides (Prout, l.c.).

C. stenoglypta Prout (1929*a*: 272). Rapa Island ("St. George" Exped.).

C. dodonaeae Prout (1929*a*: 273). Rapa Island ("St. George" Exped.).

C. leucostigma Prout (1929*a*: 276). Marquesas Islands: Hiva Oa ("St. George" Exped.).

C. licornaria Guénée (1857*a*: 285). Society Islands: Tahiti, Moorea (J. J. Walker in Prout, 1929*a*).

BOARMIA Treitschke

B. lichenina Butler (1877: 358). Loyalty Islands: Lifu.

FELICIA Thierry-Mieg (1915: 40)

F. caledonica Thierry-Mieg (1915: 40). New Caledonia.

Subfamily LARENTIINAE

CRETHEIS Meyrick (1886*a*: 192)

Cr. cymatodes Meyrick (1886*a*: 193). New Hebrides.

CHLOROCLYSTIS Hübner

C. lepta Meyrick (1886*a*: 191). Society Islands: Tahiti, Moorea ("St. George" Exped.).

C. torninubia Prout (1929*a*: 267). Marquesas Islands: Hiva Oa ("St. George" Exped.).

C. coloptilia Prout (1929*a*: 268). Marquesas Islands: Hiva Oa, Nuka Hiva ("St. George" Exped.).

C. abundata Prout (1929*a*: 269). Marquesas Islands: Hiva Oa ("St. George" Exped.).

GYMNOSCELIS Mabille

G. imparalilis Walker (1865: 1416). Marquesas Islands: Hiva Oa, Nuka Hiva. Society Islands: Tahiti, Raiatea ("St. George" Exped.).

G. erymna Meyrick (1886*a*: 192). Society Islands: Tahiti, Raiatea. Austral Islands: Rurutu. Rapa Island ("St. George" Exped.).

Subfamily OENOCHROMINAE

EUMELEA Duncan

E. degener Warren (1894: 375); Prout (1912: 53). Loyalty Islands: Lifu.

OZONA Walker

O. acrophaea Meyrick (1886*a*: 199); Prout (1912: 73). New Hebrides.

O. hesperias Meyrick (1886*a*: 196); Prout (1912: 74). New Hebrides.

DESMOBATHRA Meyrick

D. plana Warren (1894: 380); Prout (1912: 75). New Caledonia (Paris Museum, coll. Thierry-Mieg). Loyalty Islands: Lifu.

Subfamily HEMITHEINAE

THALASSODES Guénée

T. chloropis Meyrick (1886*a*: 204); Prout (1913: 96). New Hebrides (Risbec).

T. pilaria Guénée (1857*a*: 361); Prout (1913: 97). Society Islands: Tahiti. Bora Bora ("St. George" Exped.).

PRASINOCYMA Warren

P. albicosta Walker (1860: 529); Prout (1913: 98). Loyalty Islands.

PYRRHORACHIS Warren (1896*a*: 292)

Py. viridula Warren (1903: 363); Prout (1913: 162). Loyalty Islands: Lifu.

Subfamily STERRHINAE

ANISODES Guénée

A. decolorata Warren (1897*b*: 215); Prout (1934: 109). Loyalty Islands: Lifu (Prout, l.c.). Society Islands: Tahiti. Archipelago of the Tuamotus: Fakarava ("St. George" Exped.).

A. samoana Warren (1897*b*: 226) (=*A. parallela* Warren, 1897*b*: 226); Prout (1934: 119). New Hebrides. Loyalty Islands: Lifu (Prout, l.c.).

A. oblivaria Walker (1861: 643); Prout (1934: 119). From Ceylon to the Samoan Islands (Prout, l.c.).

SCOPULA Schrank

S. oppilata Walker (1861: 776); Prout (1934: 260). Loyalty Islands.

S. homodoxa Meyrick (1886*a*: 208); Prout (1934: 267). Loyalty Islands: Lifu.

S. undilinea Warren (1900: 105); Prout (1934: 270). Loyalty Islands: Lifu.

S. oxystoma Prout (1929*a*: 266). Marquesas Islands: Hiva Oa ("St. George" Exped.).

S. tersicallis Prout (1929*a*: 267). Marquesas Islands: Hiva Oa ("St. George" Exped.).

STERRHA Hübner

St. rhipistis Meyrick (1886*a*: 205); Prout (1934: 426). New Hebrides.

BURSADA Walker

B. fulvinaeata Warren (1895: 121). New Caledonia (Germain). Loyalty Islands: Lifu (Paris Museum, coll. Thierry-Mieg).

Family URANIIDAE

NYCTALEMON Dalman

N. curvata Skinner (1903: 298); Dalla Torre (1924: 8). New Hebrides (Skinner, l.c.; Aubert de la Rüe; Kowalski).

Family EPIPLEMIDAE

DIRADES Walker

D. latibrunnea Warren (1896*c*: 346); Dalla Torre (1924: 30). Loyalty Islands: Lifu.

Family AMATIDAE

EUCHROMIA Hübner

E. creusa Linné (1758: 494); Zerny (1912: 89). New Caledonia (Marie). New Hebrides (Zerny, l.c.).

E. rubricollis Walker (1864*b*: 99); Zerny (1912: 90). Loyalty Islands: Lifu (Zerny, l.c.). New Hebrides: Vaté, Port Vila (Kowalski).

Family LITHOSIIDAE

Subfamily NOLIINAE

CELAMA Walker

C. insularum Collenette (1928: 469). Society Islands: Tahiti. Rapa Island ("St. George" Exped.).

Subfamily LITHOSIINAE

OENISTIS Hübner

O. entella Cramer (1779: pl. 208, fig. D); Strand (1922: 598).

subsp. **delia** Fabricius (1787*a*: 140). New Hebrides.

HELIOSIA Hampson

H. atriplaga Hampson (1914: 586); Strand (1922: 658). Loyalty Islands.

LAMBULA Walker

L. erema Collenette (1935: 202). Marquesas Islands: Hiva Oa (Le Bronnec).

Subfamily ARCTIINAE

ARDICES Walker

A. glatignyi Le Guillou (1841: 257); Strand (1919: 159). New Hebrides.

DIACRISIA Hübner

D. lifuense Rothschild (1910*a*: 122); Strand (1919: 185). New Caledonia (Quod, Catala). Loyalty Islands: Lifu.

UTETHEISA Hübner

U. lotrix Cramer (1777: pl. 109, figs. E and F); Strand (1919: 361).

subsp. **salomonis** Rothschild (1910*b*: 181). New Hebrides: Tanna (Aubert de la Rüe), Mallicolo (Risbec).

subsp. **stigmata** Rothschild (1910*b*: 182). New Caledonia: Noumea (Antonino, Joly, Risbec, Catala), Paita (Antonino), Mt. Mou (Quod), Western Coast (Risbec). Loyalty Islands.

U. pulchella Linné (1758: 534); Strand (1919: 361). New Hebrides. Gambier Islands (Seurat).

RHODOGASTRIA Hübner

R. albivitra Hampson (1901: 502); Strand (1919: 373). New Caledonia: Noumea (Marie, coll. Paris Museum). Loyalty Islands: Lifu (Mrs. Pruvot).

Subfamily NYCTEMERINAE

NYCTEMERA Hübner

N. baulus Boisduval (1832: 200); Bryk (1937: 54). New Caledonia: Noumea (Risbec), Paita (Antonino).

N. extendens Walker (1856*a*: 1666); Bryk (1937: 62). New Hebrides.

Subfamily AGANAINAE

AGAPE Felder and Rogenhofer

A. leonina Butler (1879: 161); Gaede (1932: 2). Loyalty Islands: Lifu. New Hebrides: Mallicolo (Risbec).

NEOCHERA Hübner

N. contraria Reich (1936: 419). New Hebrides.

ASOTA Hübner

A. alienata Walker (1864*b*: 46); Gaede (1932: 12). New Hebrides: Vaté, Port Vila (Mrs. Pruvot), Mallicolo (Risbec).

A. caricae Fabricius (1775: 596); Gaede (1932: 13). New Hebrides (Mrs. Pruvot): Vaté, Port Vila (Risbec, Kowalski).

Family NOCTUIDAE

Subfamily AGROTINAE

CHLORIDEA Westwood

C. armigera Hübner (1802–1808: pl. 79, fig. 370); Hampson (1903: No. 56). New Caledonia (Vayssière, Risbec, Catala). Harmful to cotton and tobacco.

C. assulta Guénée (1852*b*: 178); Hampson (1903: No. 57). Society Islands: Tahiti (Hampson, l.c.; Collenette, 1928).

EUXOA Hübner

E. radians Guénée (1852*a*: 261); Hampson (1903: No. 285). New Caledonia (Paris Museum, coll. Thierry-Mieg).

E. infusa Boisduval (1832: 240); Hampson (1903: No. 286). New Hebrides: Aneiteum (Hampson, l.c.).

E. fumipennis Warren (1912: 5). Loyalty Islands: Lifu.

AGROTIS Hübner

A. ypsilon Rottemburg (1776: 141); Hampson (1903: No. 646). New Caledonia: Voh (Catala).

A. compta Walker (1856*b*: 404); Hampson (1903: No. 702). New Hebrides.

Subfamily HADENINAE

TIRACOLA Moore

T. plagiata Walker (1857: 740); Hampson (1905: No. 1494). Society Islands: Tahiti. Marquesas Islands: Nuka Hiva (Hampson, "St. George" Exped., and Collenette, 1935).

Subfamily CUCULLIINAE

EUMICHTIS Hübner

E. extima Walker (1857: 875); Hampson (1906: No. 2514). New Caledonia (Paris Museum, coll. Thierry-Mieg).

Subfamily ZENOBIINAE

ERIOPUS Treitschke

E. maillardi Guénée (1862: 39); Hampson (1908: No. 3417). New Hebrides (Mathew).

E. reticulata Pagenstecher (1884: 226; VI, 7); Hampson (1908: No. 3424). New Hebrides (Mathew).

E. meridionalis Collenette (1928: 471). Rapa Island ("St. George" Exped.). New Hebrides.

E. ouria Collenette (1928: 472). Marquesas Islands: Hiva Oa, Fatu Hiva ("St. George" Exped.).

CALOGRAMMA Guénée

C. festiva Donovan (1805: pl. 36); Hampson (1909: No. 3857). New Caledonia (coll. Paris Museum): Noumea (Catala). New Hebrides (Mrs. Pruvot).

PRODENIA Guénée

P. litura Fabricius (1775: 601); Hampson (1909: No. 3862). Society Islands (J. J. Walker): Tahiti (Mathew and "St. George" Exped.), Raiatea ("St. George" Exped.). Marquesas Islands (J. J. Walker): Hiva Oa, Fatu Hiva, Tahuata, Nuka Hiva. Austral Islands: Rurutu. Rapa Island ("St. George" Exped.). New Caledonia (Risbec, 1942), Baraoua (Catala). Harmful to cotton and tobacco.

SPODOPTERA Guénée

S. mauritia Boisduval (1883: 92; XIII, 9); Hampson (1909: No. 3871). Society Islands: Tahiti (J. J. Walker and "St. George" Exped.), Raiatea. Marquesas Islands: Nuka Hiva. Rapa Island ("St. George" Exped.).

PERIGEA Guénée

P. serva Walker (1858: 1689). Marquesas Islands: Hiva Oa. Society Islands: Tahiti, Raiatea ("St. George" Exped.). Larva on *Piper*.

ELYDNA Walker

E. nonagrica Walker (1864*a*: 166). Loyalty Islands (coll. Paris Museum). Society Islands: Tahiti. Rapa Island ("St. George" Exped.).

CHASMINA Walker

C. sericea Hampson (1893: 92); Hampson (1910*a*: No. 4794). New Caledonia (Paris Museum, coll. Thierry-Mieg).

C. tibialis Fabricius (1775: 578); Hampson (1910*a*: No. 4796). New Caledonia: Noumea (Antonino), Canala (Delacour). Society Islands: Tahiti (J. J. Walker, Mathew, "St. George" Exped.). Rapa Island ("St. George" Exped.).

Subfamily ERASTRIINAE

EUBLEMMA Hübner

E. quadrilineata Moore (1881: 370, XXXVIII, 14); Hampson (1910*b*: No. 5095). New Hebrides (Mathew).

E. rivula Moore (1882: 140); Hampson (1910*b*: No. 5182). Society Islands: Tahiti, Raiatea, Bora Bora ("St. George" Exped.).

AMYNA Guénée

A. natalis Walker (1858: 214); Hampson (1910*b*: No. 5704). Rapa Island ("St. George" Exped.).

A. octo Guénée (1852*a*: 233); Hampson (1910*b*: No. 5713). Marquesas Islands (J. J. Walker, Mathew): Fatu Hiva, Tahuata, Nuka Hiva ("St. George" Exped.). Society Islands (J. J. Walker): Tahiti, Bora Bora ("St. George" Exped.). New Hebrides (Mathew).

A. puctum Fabricius (1794: 34); Hampson (1910*b*: No. 5718). New Hebrides (Mathew).

EUSTROTIA Hübner

E. ritsemae Snellen (1880*a*: 57); Hampson (1910*b*: No. 5878). Society Islands: Tahiti (J. J. Walker, Mathew, Nicoll, "St. George" Exped.), Raiatea. Austral Islands: Rurutu ("St. George" Exped.).

Subfamily EUTELIINAE

BOMBOTELIA Hampson

B. jocosatrix Guénée (1852*b*: 304); Hampson (1912: No. 6206). New Caledonia: Noumea (Catala).

PHLEGETONIA Guénée

P. carbo Guénée (1852*b*: 302); Hampson (1912: No. 6278). New Caledonia. Loyalty Islands: Lifu, Maré (coll. Paris Museum).

P. delatrix Guénée (1852*b*: 304); Hampson (1912: No. 6295). Society Islands: Raiatea. Rapa Island ("St. George" Exped.).

Subfamily STICTOPTERINAE

LOPHOPTERA Guénée

L. squammigera Guénée (1852*c*: 55); Hampson (1912: No. 6408). Loyalty Islands. New Hebrides (coll. Paris Museum).

GYRTONA Walker

G. divitalis Walker (1863: 91); Hampson (1912: No. 6474). Society Islands: Raiatea ("St. George" Exped.).

Subfamily SARROTHRIPINAE

BLENINA Walker

B. donaus Walker (1857: 1215); Hampson (1912: No. 6758). Loyalty Islands (Paris Museum, coll. Donckier). New Hebrides (Paris Museum, coll. de Joannis).

Subfamily WESTERMANNIINAE

EARIAS Hübner

E. huegeli Rogenhofer (1870: 872); Hampson (1912: No. 6862). New Caledonia: Noumea (Risbec, 1942; Catala; coll. Paris Museum). New Hebrides: Espiritu Santo (Risbec). Society Islands: Tahiti (Nicoll, "St. George" Exped.), Raiatea, Bora Bora ("St. George" Exped.). Marquesas Islands: Fatu Hiva (J. J. Walker). Austral Islands: Rurutu ("St. George" Exped.).

XANTHODES Guénée

X. transversa Guénée (1852*b*: 211); Hampson (1912: No. 7112). New Hebrides (Mathew).

Subfamily CATOCALINAE

COCYTODES Guénée

C. caerulea Guénée (1852*c*: 41); Hampson (1913*a*: No. 7383). New Caledonia (Layard): Pouerihouen (Quod), Canala (Delacour), Baroua (Catala). Loyalty Islands (Whitmei). New Hebrides (Mathew).

PHYLLODES Boisduval

P. imperialis Druce (1888: 241); Hampson (1913*a*: No. 7500). New Caledonia (Millot). Loyalty Islands (Paris Museum, coll. de Joannis). New Hebrides (Hampson, l.c.; Mrs. Pruvot).

LAGOPTERA Hübner

L. miniacea Felder and Rogenhofer (1874: pl. 116, fig. 8); Hampson (1913*a*: No. 7527). New Hebrides: Tanna (Mrs. Pruvot), Mallicolo (Risbec). Also from Solomons and Fiji.

ANUA Walker

A. coronata Fabricius (1775: 596); Hampson (1913*a*: No. 7540). New Caledonia: Noumea (Paris Museum, coll. Fleutiaux). New Hebrides: Pentecôte Island (Mrs. Pruvot). Society Islands: Tahiti ("St. George" Exped.).

ACHAEA Hübner

A. serva Fabricius (1775: 593); Hampson (1913*a*: No. 7649). New Caledonia (Marie): Mt. Mou (Quod), Western Coast (Risbec). Loyalty Islands (Paris Museum, coll. Donckier): Lifu (Marshall). New Hebrides: Vaté (Turner).

A. janata Linné (1758: 527) (=*melicerta* Drury); Hampson (1913*a*: No. 7669). New Caledonia (Marie): Noumea (Risbec, Quod, Catala). New Hebrides (Mathew): Vaté, Port Vila (Kowalski). Society Islands: Tahiti (Mathew, Vesco, "St. George" Exped.). Marquesas Islands: Nuka Hiva (J. J. Walker), Tongatabu (Lister), Taiohae (Bedoc), Hiva Oa. Rapa Island ("St. George" Exped.). Gambier Islands: Taraourou Roa (Seurat). Larva on *Ricinus communis* L.

A. pentasema Prout (1919: 181). New Caledonia (Layard). Loyalty Islands: Uvea (coll. Joicey), Lifu (coll. British Museum).

A. marquesanus Collenette (1928: 476). Marquesas Islands: Hiva Oa ("St. George" Exped.).

PARALLELLIA Hübner

P. redunca Swinhoe (1900: 141); Hampson (1913*a*: No. 7687). New Hebrides (Paris Museum, coll. de Joannis).

P. prisca Walker (1858: 1385); Hampson (1913*a*: No. 7690). New Hebrides (Paris Museum, coll. de Joannis).

P. joviana Cramer (1782: 237); Hampson (1913*a*: No. 7711). Loyalty Islands: Lifu (Hampson, l.c.). New Hebrides (Paris Museum, coll. de Joannis).

GRAMMODES Guénée

G. oculicola Walker (1858: 1446); Hampson (1913*b*: No. 7778). New Caledonia: Noumea (Paris Museum, coll. Fleutiaux). Loyalty Islands: Lifu (coll. Paris Museum). Austral Islands: Rurutu ("St. George" Exped.).

CHALCIOPE Hübner

C. cephise Cramer (1779: 59); Hampson (1913*b*: No. 7794). New Hebrides: Mallicolo (Risbec).

HYPAETRA Guénée

H. discolor Fabricius (1794: 50); Hampson (1913*b*: No. 7832). Marquesas Islands: Hiva Oa, Fatu Hiva, Nuka Hiva, Tahuata ("St. George" Exped.). Society Islands: Tahiti, Moorea (J. J. Walker).

MOCIS Hübner

M. frugalis Fabricius (1775: 601); Hampson (1913*b*: No. 7857). New Caledonia (Marie): Canala (Delacour), Noumea, Voh (Catala). New Hebrides: Mallicolo (Risbec), Tanna (Aubert de la Rüe), Vaté, Port Vila (Risbec). Loyalty Islands (Paris Museum, coll. Donckier). Marquesas Islands: Fatu Hiva (Walker, "St. George" Exped.), Hiva Oa, Tahuata, Nuka Hiva ("St. George" Exped.). Society Islands: Tahiti (de la Garde, "St. George" Exped.), Bora Bora, Raiatea. Archipelago of the Tuamotus: Napuku. Austral Islands: Rurutu. Rapa Island ("St. George" Exped.).

M. trifasciata Stephens (1829: 128); Hampson (1913*b*: No. 7861). New Caledonia: Canala (Delacour), Noumea (Catala). Marquesas Islands (Walker): Hiva Oa, Fatu Hiva, Tahuata, Nuka Hiva ("St. George" Exped.). Society Islands: Tahiti (J. J. Walker), Raiatea, Bora Bora. Austral Islands: Rurutu ("St. George" Exped.).

Subfamily PHYTOMETRINAE

PHYTOMETRA Haworth

P. chalcites Esper (1789: 441); Hampson (1913*b*: No. 8310). New Caledonia: Noumea (Quod, Risbec). Loyalty Islands (Paris Museum, coll. Donckier). Society Islands: Tahiti (Walker, Vesco, "St. George" Exped.), Raiatea ("St. George" Exped.). Marquesas Islands (J. J. Walker): Hiva Oa, Nuka Hiva. Austral Islands: Rurutu. Rapa Island ("St. George" Exped.).

P. albostriata Bremer and Grey (1853: 18); Hampson (1913*b*: No. 8325). Rapa Island ("St. George" Exped.).
Larva on *Erigeron bonariensis.*

Subfamily NOCTUINAE (= Ophiderinae)

ANONIS Hübner

A. flava Fabricius (1775: 601). Marquesas Islands: Hiva Oa, Nuka Hiva. Society Islands: Tahiti. Rapa Island ("St. George" Exped.).

A. fulvida Guénée (1852*b*: 397). New Hebrides (Risbec; Paris Museum, coll. de Joannis).

A. vitiensis Butler (1886: 408). Loyalty Islands (Paris Museum, coll. de Joannis). New Hebrides (Mrs. Pruvot). Society Islands: Tahiti (J. J. Walker, Mathew, "St. George" Exped.), Raiatea. Austral Islands: Rurutu. Rapa Island ("St. George" Exped.). Larva on *Hibiscus tiliaceus* L.

SERICIA Guénée

S. layardi Hampson (1926: 121). Loyalty Islands (Layard).

S. feducia Cramer (1777: pl. 6, fig. 3). New Caledonia (Marie): Noumea (Risbec).

POLYDESMA Boisduval

P. umbricola Boisduval (1833: 108; XIII, 5). New Caledonia: Noumea (Risbec), Baraoua (Catala). New Hebrides (Kowalski): Ambryn (Mrs. Pruvot). Society Islands: Tahiti, Raiatea ("St. George" Exped.).

AEDIA Hübner

A. sericea Butler (1882: 230). Austral Islands: Rurutu ("St. George" Exped.).

LACERA Guénée

L. alope Cramer (1777: pl. 286). New Caledonia (Marie).

SERRODES Guénée

S. inara Cramer (1777: pl. 239). Loyalty Islands (Paris Museum, coll. Donckier). New Caledonia (Marie). New Hebrides (Paris Museum, coll. de Joannis).

OPHIDERES Boisduval

O. salaminia Fabricius (1775: 17). New Caledonia (Marie, Germain). New Hebrides: Vaté, Port Vila; Mallicolo (Risbec).

O. fullonica Linné (1758: 812). New Caledonia (Marie, Millot, Longuet): Noumea (Quod; Paris Museum, coll. Fleutiaux), Canala (Delacour). Loyalty Islands (Paris Museum, coll. Donckier). New Hebrides (Mrs. Pruvot; Paris Museum, coll. de Joannis): Mallicolo (Risbec). Society Islands: Tahiti (Vesco).

O. materna Linné (1758: 840). New Caledonia (Marie).

ANTICARSIA Hübner

A. irrorata Fabricius (1787*a*: 506). Society Islands: Tahiti, Moorea, Raiatea. Rapa Island ("St. George" Exped.).

Subfamily HYPENINAE

SIMPLICIA Guénée

S. caenensalis Walker (1858: 94). Marquesas Islands: Hiva Oa. Austral Islands: Rurutu. Society Islands: Tahiti (J. J. Walker, "St. George" Exped.).

HYDRILLODES Guénée

H. melanozoma Collenette (1928: 481). Rapa Island ("St. George" Exped.).

H. crispipalpus Collenette (1928: 482). Society Islands: Tahiti ("St. George" Exped.).

HYPENA Schrank

H. walkeri Collenette (1928: 482). Society Islands: Tahiti ("St. George" Exped.).

H. longfieldae Collenette (1928: 483). Marquesas Islands: Hiva Oa. Rapa Island ("St. George" Exped.).

H. sanctigeorgii Collenette (1928: 483). Marquesas Islands ("St. George" Exped.).

FAUTAUA Collenette (1928: 484)

F. diagonalis Collenette (1928: 484). Society Islands: Tahiti ("St. George" Exped.).

F. innupta Collenette (1928: 485). Society Islands: Tahiti ("St. George" Exped.).

LUCERIA Walker

L. oculalis Moore (1877: 614). Rapa Island ("St. George" Exped.).

Subfamily HYBLAEINAE

HYBLAEA Fabricius

H. puera Cramer (1777: 10). New Hebrides (Prout, 1919). Marquesas Islands: Hiva Oa ("St. George" Exped.).

Family LYMANTRIIDAE

EUPROCTIS Hübner

E. dolichocera Collenette (1938: 371). New Hebrides: Vaté, Port Vila (Kowalski).

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Flora of Johnston Island, Central Pacific

F. R. FOSBERG[1]

THE FIRST LIST of plants of Johnston Island, published in 1931 by Christophersen (*Vascular Plants of Johnston and Wake Islands.* Bernice P. Bishop Mus. Occas. Papers 9(13): 1–20, 1931), was based on the collections of the Tanager Expedition in 1923. Three species were reported and a few notes on the vegetation were included. The three species were *Lepturus repens, Boerhavia diffusa,* and *Tribulus cistoides.* There is little doubt that these made up the whole vascular flora at the time, as Johnston is a very small, low, sandy, barren island and would not have been difficult to cover thoroughly. Few smaller floras are known (see Fosberg, F. R., *Vegetation of Vostok Island, Central Pacific.* Bernice P. Bishop Mus., Spec. Pub. 30: 19, 1937).

In the late 1930's aviation activities began to change the island. It became an important air base during the war and when I paid it a brief visit during 1946 there was apparently no original vegetation remaining, the whole island being occupied by runways and buildings with disturbed ground in the open places and along paths and roadsides. The plant most noticeable, though not most abundant at that time, was *Pluchea odorata.* Doubtless this had been brought from Honolulu, where it is common, but whether it was introduced accidentally or deliberately is not known to me. A number of other plants were noticed growing as ornamentals around the buildings.

On November 1, 1946, my brother, Kenneth P. Fosberg, made, at my request, a collection of all the plants that he could find during a day spent on the island. Twenty-six species in all were collected, most of them in duplicate. A coconut seedling was seen but not collected. An almost complete set of plants was presented to the Bernice P. Bishop Museum in Honolulu. The remainder were sent to Washington, but were apparently lost in the mail.

The increase from 3 to 27 species consists mainly of species that are obvious introductions, either deliberate, as cultivated plants, or accidental, as weeds. Only two, *Messerschmidia argentea* and *Scaevola frutescens,* are species that might be expected to be native on an island such as Johnston, and they are both conspicuous enough so they could not possibly have been missed by the Tanager party if they had been present in 1923. The flora has thus been greatly enriched by human activity, and the original flora has maintained itself. This could be likely only in a pioneer habitat such as a dry coral island.

All the weeds as well as the planted species are common on Oahu, Hawaiian Islands. Whether the weed seeds came with nursery stock or by accidental adherence to plane or cargo is hard to know; but observations around other Pacific air bases suggest that the latter process is not negligible.

The list of species follows with such notes on occurrence as were provided by the collector. The general habitat for all is coral sand. Determinations are my own.

Cenchrus echinatus L. Abundant. *K. P. Fosberg 7.*

Chloris inflata Link. Abundant. *K. P. Fosberg 11.*

Cynodon dactylon (L.) Pers. One small patch seen. *K. P. Fosberg 16.*

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Eleusine indica (L.) Gaertn. Rare. *K. P. Fosberg 17.*

Lepturus repens (Forst.) R. Br. Abundant. *K. P. Fosberg 9.*

Setaria verticillata Beauv. Common locally. *K. P. Fosberg 26.*

Cocos nucifera L. One seedling seen.

Casuarina equisetifolia L. Commonly planted. *K. P. Fosberg 20.*

Boerhavia diffusa L. Abundant, especially in places not walked on too much. *K. P. Fosberg 6.*

Amaranthus viridis L. Common along fences. *K. P. Fosberg 3.*

Portulaca oleracea L. Common. *K. P. Fosberg 24.*

Pithecellobium dulce (Roxb.) Benth. Rare, planted. *K. P. Fosberg 22.*

Prosopis juliflora (Sw.) DC. (sens. lat.). Rare, planted. *K. P. Fosberg 25.*

Euphorbia geniculata Ort. Abundant locally on small dune. *K. P. Fosberg 8.*

Euphorbia hypericifolia L. Common along fences and edges of walks. *K. P. Fosberg 2.*

Ricinus communis L. Common. *K. P. Fosberg 10.*

Tribulus cistoides L. Abundant. *K. P. Fosberg 5.*

Thespesia populnea (L.) Sol. Commonly planted. *K. P. Fosberg 18.*

Terminalia catappa L. Abundantly planted. *K. P. Fosberg 23.*

Thevetia thevetioides (H. B. K.) Schum. Planted, not common. *K. P. Fosberg 19.*

Cordia sebestena L. Planted, rare. *K. P. Fosberg 21.*

Messerschmidia argentea (L.) Johnst. Planted, occasional. *K. P. Fosberg 14.*

Vitex trifolia L. Planted, occasional. *K. P. Fosberg 15.*

Scaevola frutescens (Mill.) Kr. Rare, under *Messerschmidia* tree. *K. P. Fosberg 13.*

Pluchea indica Less. Uncommon, five or six plants seen. *K. P. Fosberg 4.*

Pluchea odorata (L.) Cass. Occasional. *K. P. Fosberg 1.*

Sonchus oleraceus L.? Occasional. *K. P. Fosberg 12.*

Notes on Marine Algae of New Zealand. I.

VICTOR W. LINDAUER[1]

AS WOULD BE EXPECTED, considering its geographical position, New Zealand has always attracted the attention of the scientific collector, and it may, therefore, seem strange that certain conspicuous marine algae have hitherto escaped critical examination and, in some cases, have been overlooked entirely. This series of papers will deal with such, together with occasional notes on the New Zealand algal flora generally.

Family PHAEOPHYCEAE

Ectocarpus bracchiolus sp. nov.

Fig. 1*d–i.*

Frondibus minutis, 4 mm. altis, epiphyticis, orientibus e massa densa filorum serpentium; thallis tortuosis, eandem latitudinem semper servantibus, 15–24 μ latis, cacuminibus obtusis, articulis 1–4–plo latioribus, ramis raris, secundatis vel irregularibus, longis, saepius simplicibus, divaricatis, subapicaliter crescentibus, chromatophoris patinae similibus, nullis capillis; sporangia unilocularia non visa; sporangiis pluriloculariibus (1) terminalibus, erectis, 51–62 μ longis, 34–45 μ latis, positis in pedicellis 0.5 mm. altis e cellulis 12 vel pluribus constantibus; (2) lateralibus, sessilibus vel cum pedicellis unicellularibus, 62–72 μ longis, 48 μ latis, saepius ad fila ad angulos rectos vergentibus.

Fronds minute, 4 mm. high, epiphytic, arising from a dense mass of creeping filaments; thalli tortuous, of same width throughout, 15–24 μ wide, tips obtuse, articulations 1–4 times width, branches sparse, secund or irregular, long, mostly simple, divaricating, growth subapical, chromatophores plate-like, hairs absent; unilocular sporangia not seen; plurilocular sporangia (1) terminal, erect, ovoid-acuminate, 51–62 μ long and 34–45 μ wide, on pedicels 0.5 mm. high of 12 or more cells; (2) lateral, oval to ovoid, often bifurcate, sessile or with pedicels of 1 cell, 62–72 μ long and 48 μ wide, most often at right angles to the filament.

E. bracchiolus has affinities with *E. rhodochortonoides* Boerg. but the dimensions of its cells and the shape and position of its plurilocular sporangia are different. On the other hand, the sporangia more closely resemble, but are not identical with, those of *E. breviarticulatus* J. Ag., being both shortly stalked and inserted at right angles, but the vegetative thallus shows important differences. In this connection it approaches more closely *E. variabilis* Vickers in which the cells are much shorter and of nearly the same length throughout.

Distribution: On *Cladophora colensoi,* in pools, covering part of the filament with a low, soft, yellowish, hairy fringe. Pegasus, Stewart Island, the type locality; in the early autumn.

Type specimen, No. 9975, Herbarium Lindauer.

Sphacelaria stewartensis sp. nov.

Fig. 1*a–c.*

Frondibus parvis, cristatis, epiphyticis, 4–5 mm. altis, orientibus e dense aggregatis intrudentibus filis, axibus primariis thallorum percurrentibus, 30–42 μ latis, cum paucis rhizoidibus descendentibus, axe mox subraro egerente pinnas longas, simplices vel sparse ramosas, 15–24 μ latas, axi primario similes, cacuminibus obtusis sed numquam conspicuis, interdum subattenuatis; articulis saepius longioribus quam latioribus, parte superiore paris cuiusque cellularum maiore quam parte inferiore et pericys-

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to distincto praedita, sectionibus longitudinalibus 1–3, sectionibus transversis saepe nullis, interdum singulis, numquam pluribus; capillis nullis; sporangiis unilocularibus 39–45 μ longis, 21–24 μ latis, numerosis, ovatis, saepius ternis vel quaternis in ramulis sympodialibus qui in seriebus irregularibus secundatis vel alternatis per maiorem partem thalli gignuntur; sporangia plurilocularia non visa; propagula non visa.

Fronds small, tufted, epiphytic, 4–5 mm. high, arising from closely packed penetrating filaments, main axes of thalli percurrent, 30–42 μ wide with but few descending rhizoids, axis soon giving off somewhat sparingly, long, simple or sparsely branched pinnae 15–24 μ wide similar to the main axis, tips obtuse but never conspicuous, sometimes somewhat attenuated; articulations usually longer than wide, the upper of each pair of cells larger than the lower and provided with a distinct pericyst, longitudinal divisions 1–3, transverse divisions usually wanting or one at the most; hairs lacking; unilocular sporangia 39–45 μ long, 21–24 μ wide, plentiful, oval, generally in threes or fours on sympodial branchlets which appear in irregular secund or alternate series over most of the thallus; plurilocular sporangia not seen; propagula not seen.

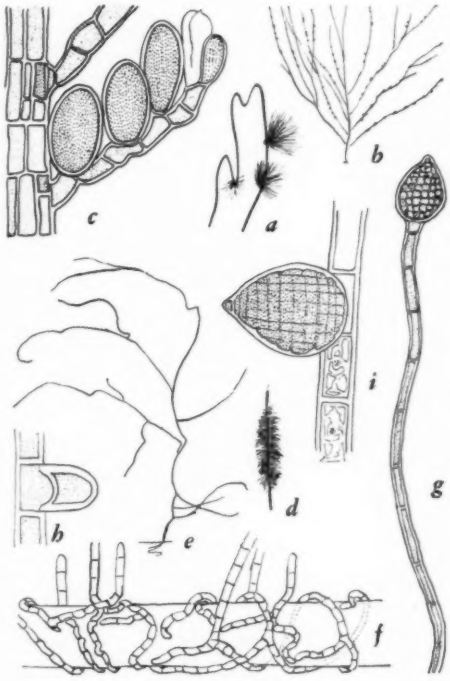

FIG. 1. Species of *Sphacelaria* and *Ectocarpus*. *a–c, Sphacelaria stewartensis* sp. nov.: *a*, in position on host (× 1.5); *b*, habit sketch (× 5); *c*, unilocular sporangial sympodium (× 330). *d–i, Ectocarpus bracchiolus*: *d*, in position on host (× 1)); *e*, habit sketch (× 15); *f*, creeping basal filaments on host; *g*, erect filament with plurilocular sporangium (× 166); *h*, initial of plurilocular sporangium (× 330); *i*, mature plurilocular sporangium (lateral) (× 330).

The plant is epiphytic on the upper segments of *Xiphophora chondrophylla*, forming small, isolated tufts, which, when removed, leave small cavities in the surface of the host. The branches are long and straggly, the lowest generally longest.

This species is closest to *S. reinkei* Sauv., of Tasmania, which plant is epiphytic on *Cystophora;* but dimensions of the new species are smaller, its branching is pinnate and not appearing dichotomous; it has no hairs, no felted basal portion, and the number of transverse divisions of the articulations is fewer.

It also resembles *S. sympodicarpa* Sauv., of Europe, but is larger and has no creeping filaments; *S. chorizocarpa* Sauv., of Australia, but is lacking in hairs and plurilocular sporangia; *S. borneti* Reinke, but again has no plurilocular sporangia. Sauvageau, however, considers *S. borneti* to be identical with *S. reinkei* Sauv.

Distribution: Epiphytic on *Xiphophora chondrophylla* at Twilight Bay, Pegasus, Stewart Island, the type locality; most abundant in March.

Type specimen, No. 9955, Herbarium Lindauer; iso-types distributed in Lindauer (1948), *Algae Nova-Zelandicae Exsiccatae,* Fasc. XIII, No. 311.

Spatoglossum chapmanii sp. nov.

Fig. 2*a–f*.

Fronde erecta, complanata, ecostata, subpalmata, dichotoma, haud concentrice striata, ad 80 cm. alta, membranosa vel cortacea, subglauca

vel fusco-oleaginia; haustorio stuposo; stipite brevi, stuposo, mox in laminam latam cuneatim patente, terminaliter diviso in numerosa longa vel subdichotomopalmata segmenta cuneos latos simulantia; sinubus rotundatis, rursus terminaliter divisis in lata linearia vel lingulata segmenta; apicibus rotundatis; marginibus intergris vel perraro dentatis; sporis in series plus minusve longitudinales sparsis.

Frond erect, flat, ecostate, subpalmate-dichotomous, not concentrically striate, up to 80 cm. high, membranous to coriaceous, greenish-olive to dark olive-brown, holdfast stupose, stipe short, stupose, soon expanding cuneately into a wide blade, splitting terminally into numerous long, palmate or subdichotomous-palmate broadly cuneate segments, sinuses rounded, dividing again into terminal broadly linear or lingulate segments, apices rounded, margins entire or very sparsely toothed; sporangia scattered or in more or less longitudinal bands.

Named in honour of Professor V. J. Chapman, of Auckland University College, New Zealand, whose assistance and friendship over a period of many years have been greatly valued.

The plants are probably dioecious, but the oögonia have not been definitely recognized. The antheridia are clustered into protruding, elongated, arched sori, up to 210 μ wide and 60–75 μ high, containing small, cuboidal loculi. The sporangia, each forming a quadrant of spores, are large, protruding, broadly pyriform or clavate, with very dark content and thick walls, solitary or closely scattered into somewhat longitudinal lines, 84–108 μ high and 75–105 μ wide, on stalks of 1–2 cells, the latter not always clearly visible. Structure of from 2–3 layers of large, colorless medullary cells, bounded by one row of smaller subcortical cells and one cortical layer of cuboidal photosynthetic cells in width equal to, or half that of, the subcortical cell immediately below.

There appear to be two very distinct ecological forms of this plant: the one greenish, membranous, broad, flabellate; the other brown, subcoriaceous, narrow, dichotomous. The former

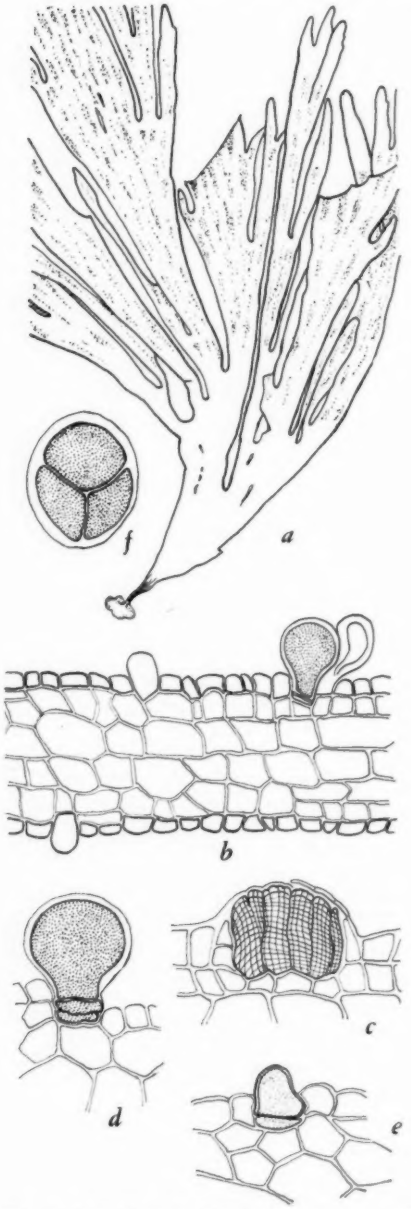

FIG. 2. *Spatoglossum chapmanii* sp. nov.: *a*, habit sketch (× 0.2); *b*, transverse section of frond; *c*, antheridial sorus in transverse section; *d*, tetrasporangium in transverse section; *e*, initial of tetrasporangium in transverse section; *f*, tetrasporangium, surface view.

grows in comparatively still, sheltered situations, and small plants of this form closely resemble *Taonia,* from which they differ macroscopically, in the lack of transverse, concentric bands. The latter is the commoner form.

In structure the plant agrees most closely with *S. solierii* (Chauv.) Kuetz., from the Mediterranean, as distributed by Schiffner, *Algae Marinae,* No. 689, but in vegetative habit is closer to *S. cornigerum* J. Ag. of Australia; but no exact comparison can be made until the Australian plant is more extensively collected.

Distribution: In the upper sub-littoral and extending downwards, often hanging from rock just below low-water line or growing on rocks on the bottom. Found more or less abundantly from Whangarei to the Bay of Plenty, Wellington, Bluff, Stewart Island (type locality). Spring and summer.

Type specimen No. 6702, Herbarium Lindauer; iso-types distributed in Lindauer (1946), *Algae Nova-Zelandicae Exsiccatae,* No. 209.

Myrionema compactum sp. nov.

Fig. 3*a–e.*

Thallo epiphytico, pulvinum parvum tenuem glaucum lineamentis irregularibus formante, coniuncto ad nodos et internodos superiores Hormosirae banksii var. gracilis; strato basali prostrato monostromatico, constante e filis plus minusve tortuosis, dense adpressis, 9–12 μ diametro, subdichotome ramosis praesertim prope marginem; filis erectis 6–12 cellularum, brevibus, latis, cylindricis, obtusis, 54–100 μ altis, 15–21 μ latis, interdum duobus filis erectis ex eadem cellula basali orientibus; unilocularibus sporangiis sessilibus, rarius breviter pedicellatis, directe e strato librato orientibus aut rarius lateraliter e parte superiore filorum erectorum, late clavatis vel cylindricis, 40–80 μ altis, 15–27 μ latis, irregulariter per frondem sparsis; pluriloculariibus sporangiis ad 12 ordines loculorum altis, in pedicellis 1–5 cellularum positis, seriebus e 2–4 constantibus, 60–99 μ altis, 15–18 μ latis, parietibus transversis libratis; capillis 9 μ latis; chromatophoris parvis, disciformibus.

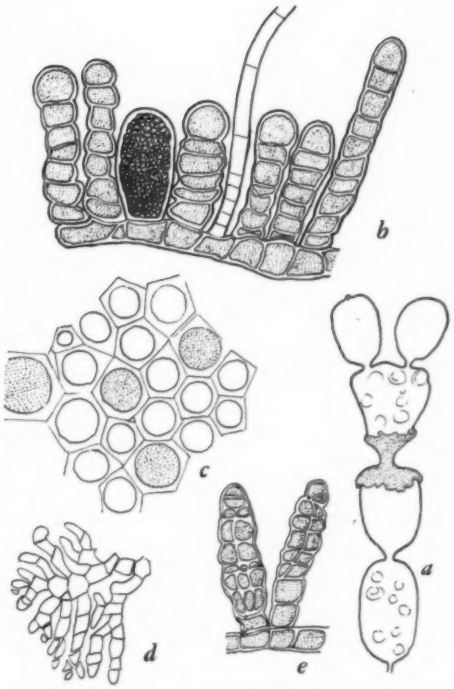

FIG. 3. *Myrionema compactum* sp. nov.: *a,* colony on host (× 2); *b,* erect filaments and unilocular sporangium (× 325); *c,* surface view showing erect filaments, sporangia (shaded), and a hair (× 325); *d,* tip of prostrate filament (× 200); *e,* plurilocular sporangia (× 300).

Thallus epiphytic, forming a small, thin, dull-grey, skin-like cushion irregular in outline, attached to the upper nodes and internodes of *Hormosira banksii* var. *gracilis;* prostrate basal layer monostromatic, composed of more or less tortuous, closely adpressed filaments 9–12 μ in diameter, subdichotomously branched, especially towards the periphery; erect filaments of 6–12 cells, short, broad, cylindrical, obtuse, 54–100 μ high and 15–21 μ broad, sometimes 2 erect filaments arising from the same basal cell; unilocular sporangia sessile, more rarely shortly pedicelled, arising directly from the horizontal stratum or, more rarely, laterally from the upper

part of the erect filaments, broadly clavate or cylindrical, 40–80 μ high and 15–27 μ wide, scattered irregularly over the frond; plurilocular sporangia up to 12 tiers of loculi in height, on pedicels of 1–5 cells, 2–4-seriate, 60–99 μ high and 15–18 μ wide, cross walls horizontal; hairs 9 μ wide; chomatophores small, disciform.

In its typical form the filaments are short and squat, but they vary a great deal in different areas of the colony, becoming longer and more slender. Unilocular and plurilocular sporangia are scattered promiscuously among the erect filaments or, in the case of the latter, taking their place in the course of the maturation of the filaments. As the colony matures the host seems to shed its cuticle to which the *Myrionema* remains attached, and the whole peels off naturally in due course. Dark-colored cells of homogeneous content are present, and resemble unilocular sporangia in size and shape and are, perhaps, merely degenerate sporangia.

The species under discussion is closest to *M. primarium* Setch. et Gard. (=*M. foecundum* f. *majus* S. et G.), from which it differs in its very much more massive proportions, especially as to width of erect filaments, hairs, and plurilocular sporangia, and in the number of loculi.

Growing on *Hormosira banksii* var. *gracilis* in tide-pools in the upper littoral.

Distribution: Known only from the type locality, Long Beach, Russell, Bay of Islands.

Type specimen, Lindauer, No. 11306 (formalin material), deposited in the Herbarium of Auckland University College.

Genus **Herponema** J. Ag.

On reading Agardh's (1882: 55) diagnosis of his new genus, *Herponema,* it becomes apparent that the characters emphasized by him are vague and have been the cause of much confusion in New Zealand, where two species of the genus supposedly existed. The following is a translation of the diagnosis:

Herponema J.Ag. mscr. — Frond flat-cushioned or subglobose, not particularly gelatinous, made up of a double layer: *axis* primarily decumbent, and forming along the periphery of a centrifugally rising cushion rather simple or sparsely branched filaments radiating from the center and attached below, then forming a hypothallic layer at times barely distinguishable; *peripheral* layer consisting of rising filaments, then of filaments erect, very dense, cylindrical, articulate, thickish, stiff, all of similar shape; single sporangia terminal in the simple peripheral filaments, or lateral on the modified branchlets, hollow where the apex is broken.

Agardh included three species in *Herponema: H. pulvinatum, H. velutinum,* and *H. maculans,* which the writer proposes to discuss in turn.

Herponema pulvinatum J.Ag.

Agardh described the species from a specimen sent to him by Harvey under the herbarium name of *Ectocarpus pulvinatus.* The species was, however, never described by Harvey as such, but it is here suggested that Harvey described it at an earlier date (1855: 221) as *Sphacelaria pulvinata,* which name the plant still bears. It is unfortunate that Harvey's material is not available for comparison, but an analysis of the descriptions of *Herponema pulvinatum* and *Sphacelaria pulvinata* shows that the two plants are identical in all major details; furthermore, the habit and the host plant of both are the same. It is noteworthy that de-Toni (1895: 397 and 508) gives *Ectocarpus pulvinatus* Harv. as the synonym for both *Herponema pulvinata* and *Sphacelaria pulvinata.* Furthermore, the writer has collected a plant which answers to the description of *Sphacelaria pulvinata* Harv. and found it actually to be a species of *Sphacelaria,* and has distributed that plant in his *Algae Nova-Zelandicae Exsiccatae* (1942), No. 131.

Herponema velutinum (Grev.) J.Ag.

H. velutinum (Grev.) J.Ag.=*Sphacelaria ? velutina* Grev.=*Elachista velutina* (Grev.) Fries=*Ectocarpus velutinus* Kuetz.=*Streblonema ? velutinum* (Grev.) Thur., *vide* de-Toni (1895: 578).

This plant belongs to a group of parasitic species possessing vertical basal penetrating

filaments instead of a basal layer of horizontal filaments. Hamel (1931–39: XII), however, by implication designated it as the type species of *Herponema.* The writer, on the other hand, is of the opinion that although J.Agardh listed *H. pulvinata* and *H. velutina* before describing *H. maculans,* his description of the genus is essentially based on the latter species. The description fits it far better than it does either of the others, and the three diagrams (Tab. III, Figs. 4a, b, and c) are illustrations of that plant alone. It therefore seems more logical to regard *H. maculans* as type of the genus, especially since J.Agardh in his generic diagnosis points out that the plants possess two types of filaments, (1) horizontal and (2) erect; and since neither *H. pulvinata* nor *H. velutina* has a distinct basal system of horizontal filaments they cannot possibly be regarded as typical of the genus, or, in fact, as members of it. On the other hand most authors have placed the species *velutina* in *Ectocarpus.* In fact, the plant might well remain there until a more careful study has been made of the genera concerned, namely, *Ectocarpus, Herponema, Compsonema,* and *Hecatonema.*

Herponema maculaeforme (J.Ag.) Laing
Fig. *4a–j.*

H. maculaeforme (J.Ag.) Lg. (orthog. mut.)=*H. maculans* J.Ag.=*Elachista maculaeformis* J.Ag.=*Herponema maculaeformis* (J.Ag.) Lg. (Note: J. Agardh had originally used the specific epithet *maculaeformis* but, by some oversight, he renamed the species *maculans* when transferring it to his new genus, *Herponema.* Laing (1929: 579) rectified the error but neglected to alter the gender of the termination, which has here been done.)

The identity of *Herponema maculaeforme* has for many years evaded New Zealand algologists. It had originally been described by J. Agardh (1877: 4) as *Elachista maculaeformis* but in 1882 (p. 56), he renamed it *Herponema maculans.* The plant does not, therefore, appear in Hooker's *Handbook* (1867), which was for many years the only book of reference to the New Zealand algae possessed by local workers. In due course Kjellman (1891–93: 187) reduced the genus to *Ectocarpus,* as had also been

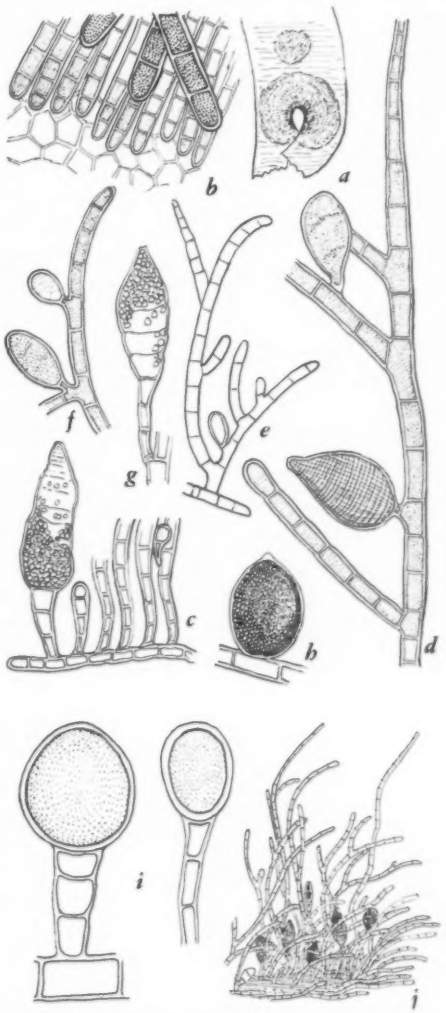

FIG. 4. *Herponema maculaeforme* (J.Ag.) Laing: *a,* colony on host (× 2); *b,* basal rhizoids with tips of three erect filaments for comparison (× 150); *c,* rhizoid with erect filaments (× 150); *d,* erect filament, somewhat straightened, with sporangia (× 150); *e,* small plant (× 130); *f,* tip of filament (× 150); *g, b,* old plurilocular sporangia (× 150); *i,* unilocular sporangia (× 150); *j,* showing basal, rising, and erect filaments, and sporangia (× 20).

done by Hauck (1885: 324–326); but much later Laing (1926: 138), and Lindauer (1947: 544–545), still included both *Herponema maculaeformis* and *H. pulvinata* in their lists.

As the description given by Agardh is rather vague and incomplete, a more detailed description is here given.

Thalli forming small, low, soft, furry, circular or confluent mats up to 1.5 cm. in diameter on the upper segments of *Xiphophora chondrophylla,* black when submerged, brown when dry, colonies consisting of a prostrate basal system of horizontal, closely adpressed, radiating filaments, 15 μ wide, and an erect system of slightly broader filaments, about 1 mm. high and 21–24 μ wide, tapering slightly downwards, arcuate, sparsely and irregularly divaricatingly branched, the branches most frequently arising on the convex side of the bent rachis and of the same width; tips obtuse, swollen or attenuated into a hair; articulations about 2–3 times as long as wide; protoplast of a dense golden-brown, granulated, with chromatophores closely packed, rod-like; unilocular sporangia globose or ovate, about 42–60 μ high and 45 μ wide, pedicellate on the prostrate filaments; plurilocular sporangia very numerous, irregular in size and shape, ovate, ovate-acuminate or siliquose, up to 150 μ high and 66 μ wide, pedicellate or sessile, terminal or lateral; loculi pluriseriate.

The height of the filaments varies a great deal according to their position in the colony. The plurilocular sporangia, recorded here for the first time, are excessively abundant and sometimes resemble the unilocular sporangia to such an extent that it is very difficult to distinguish between them; plurilocular sporangia of this type are, however, generally sessile and lateral on the branches, whereas the unilocular sporangia are usually pedicellate on the basal horizontal stratum.

Distribution: This plant is found from Wellington southwards, becoming very abundant on Stewart Island in April and May, otherwise appearing sporadically and sparsely throughout the year.

Distributed in Lindauer (1946), *Algae Nova-Zelandicae Exsiccatae,* No. 229, as *Hecatonema?*

It will be seen from the above description that the plant, *H. maculaeforme,* which alone remains of the triumvirate of J. Agardh's species, could seemingly be placed in Kuckuck's genus, *Compsonema* and, vague as Agardh's diagnosis of *Herponema* may be, it certainly appears to coincide with the description of what is understood as *Compsonema* in its broad sense, or with a group of algae which might embrace *Compsonema.* The generic epithet *Herponema* (1872) antedates *Compsonema* (1899); furthermore, Kuckuck's genus was built around a species which is still unique in the possession of but one chromatophore (*vide* Feldmann: 1937: 119) in each cell together with a conspicuously stratified filament producing endogenous hairs. Should *Compsonema* be accepted in this narrow sense it is plain that at least some of the Setchell and Gardner species attributed to *Compsonema* do not belong there, but should, perhaps, be included in the older genus, *Herponema,* and it is possible that some species of *Hecatonema* would be more properly attributed to *Herponema,* or that the former genus might be entirely absorbed by the latter.

Hapalospongidion durvilleae sp. nov.

Fig. 5*e–i.*

Thallis parasiticis, erectis, pannos humiles ellipticos in *Durvillea antarctica* formantibus, filamentis artis, paene ecoloribus, 525–600 μ altis, 11.25 μ latis, filamentis singulis constantibus e cellulis ad 15, cellulis 3–6-cies longioribus quam latioribus; sporangiis unilocularibus ellipsoidis, 71 μ altis, 22.5 μ latis, terminalibus in brevibus erectis filamentis.

Thalli parasitic, erect, forming low, ellipsoidal patches on *Durvillea antarctica;* filaments simple, narrow, almost colorless, 525–600 μ high and 11.25 μ wide, each filament consisting of up to 15 cells, cells 3–6 times as long as wide; unilocular sporangia ellipsoidal, 71 μ long and 22.5 μ wide, terminal on short erect filaments. The nature of the basal system of penetrating

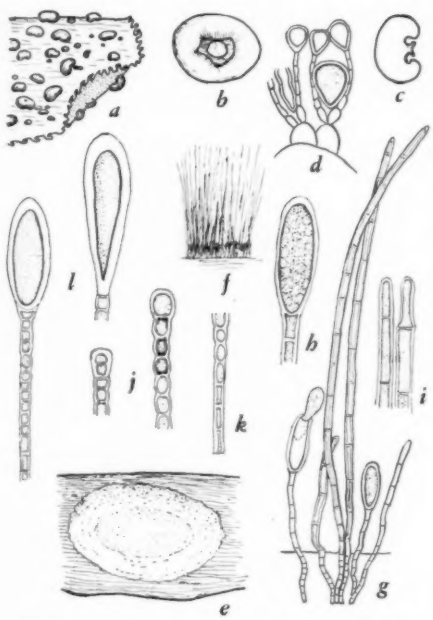

FIG. 5. Species of *Leathesia* and *Hapalospongidion*. *a–d, Leathesia novae-zelandiae* sp. nov.: *a,* colonies on host (× 0.5); *b,* undersurface (× 2); *c,* vertical cut through long axis of smaller specimen (× 2); *d,* paraphyses and sporangia (one dehisced) (× 140). *e–i, Hapalospongidion durvilleae* sp. nov.: *e,* on host (× 0.5); *f,* habit sketch (× 35); *g,* filament with penetrating rhizoids and sporangia (one injured) (× 150); *h,* a sporangium (× 280); *i,* tips of filaments (× 266). *j–l, Hapalospongidion saxigenum* sp. nov.: *j,* tips of filaments (× 166); *k,* base of filament (× 166); *l,* unilocular sporangia (× 170).

filaments has not yet been satisfactorily determined.

The plants form small, oval patches at first, but later these become confluent and cover large areas within the margins of the blade of the host, not only on one surface of the blade but also on the opposite surface, the colony assuming exactly the same size and shape of that on the opposing surface, as if the parasite had grown right through the thallus of its host. The color, *en masse,* is dark brown and velvety but, on drying, it becomes yellowish-sienna and is very conspicuous on the dark, almost black frond of the dry *Durvillea.* The protoplast is very light straw-colored, almost colorless under the microscope, but the sporangia are somewhat darker and very numerous in a low line among the long, erect filaments. This lack of color of the protoplast is in accordance with the plant's parasitic state. The chromatophores are small, disc-shaped, sparse, except at the tips.

This species may prove to belong to a new genus but in the meantime, until the plant is cultured, it is as well to place it here tentatively.

Distribution: So far known only from Stewart Island, the type locality, where it is abundant in autumn and winter.

Type specimen No. 6253, Herbarium Lindauer; iso-types were distributed in Lindauer (1946), *Algae Nova-Zelandicae Exsiccatae,* No. 230, as *Herponema?*

Hapalospongidion saxigenum sp. nov.

Fig. 5*j–l.*

Thallis minutis, erectis, aggregatis, fulvis, lubricis; filis simplicibus, arcte clavatis, 225–725 μ altis, 6–18 μ latis, constantibus e cellulis ad 60, cacuminibus obtusis, cellulis vix longioribus quam latioribus, paene tumido-cylindricis vel moniliformibus, cellulis basalibus aliquanto arctioribus, orthogoniis, ecoloribus, 2-plo longioribus quam latioribus; chromatophoris minutis, disciformibus; unilocularibus sporangiis grandibus, terminalibus, ovatis vel clavatis, 105–170 μ altis, 36–45 μ latis, parietibus cellularum conspicue crassis, pedicello constante e 12 vel pluribus cellulis, superne 12 μ latis, infra 4–6 μ latis; sporangia plurilocularia non cognita.

Thalli minute, erect, gregarious, dull yellowish-brown, lubricous; filaments simple, narrowly clavate, 225–725 μ high and 6–18 μ wide, consisting of up to 60 cells, tips obtuse, cells scarcely longer than wide, somewhat barrel-shaped or moniliform, basal cells somewhat narrower, rectangular, colorless, twice as long as wide; chromatophores minute, disciform; unilocular sporangia large, terminal, oval or clavate, 105–170 μ high and 36–45 μ wide, with conspicuously thick cell walls, pedicel of 12 or more cells 12 μ wide above and 4–6 μ wide below;

plurilocular sporangia unknown. The basal distromatic or tristromatic layer characteristic of the genus is barely distinguishable in this species, but it appears to exist.

The new species is closely related to *H. gelatinosum* Saunders in habit and stature but differs principally in the absence of plurilocular bodies, and in the poorly developed basal layer. It also has affinities with *H. pangoensis* (Setch.) Hollenbg. which is, however, smaller in its dimensions.

Forming low, slippery, continuous, suede-like patches mostly of large size on smooth boulders, somewhat resembling *Ralfsia,* but not crusty. On removal from rocks it becomes a pulpy, gelatinous mass. Small fragments on the microscope slide press out, under the cover slip, into circular tufts of radiating filaments with the bases closely adpressed in the center.

Distribution: In the intertidal region in the more exposed situations probably throughout New Zealand. Definitely known from Russell, Pihama (Taranaki), Kaikoura, Stewart Island (the type locality). Mostly summer and autumn.

Type specimen No. 11320, Herbarium Lindauer, deposited in the Herbarium of Auckland University College.

Leathesia novae-zelandiae sp. nov.

Fig. 5*a–d.*

Frondibus epiphyticis, fusco-oleaginis, glabris, solidis, hemisphaericis, ad 7 mm. diametro, 4 mm. altis, filamenta e 5–9 cellulis assimilantibus, clavatis, cellula terminali obovoida; sporangiis unilocularibus obovoidis, 71–90 μ longis, 34–45 μ latis.

Fronds epiphytic, olive-brown, glabrous, solid, hemispherical, up to 7 mm. in diameter and 4 mm. high, assimilating filaments of 5–9 cells, clavate, the terminal cell obovoid; unilocular sporangia obovoid, 71–90 μ long and 34–45 μ wide.

The juvenile frond arises from a prostrate basal system of radial, compact, branched filaments, and may readily be mistaken for *Myrionema.* The periphery of the mature thallus is oval, circular, or slightly irregular in outline, convolutions on the surface are wanting, but a dimple sometimes develops in the center of the rounded upper surface. The under surface is concave even in specimens of 1 mm. in diameter and less, so that the detached thallus resembles the "cap" of a mushroom. The attachment appears in the center of the concavity as a slightly raised dark brown patch, 1.5–2 mm. in diameter in the largest specimens; this may be distinctly seen from the reverse side of the frond of the host plant if held to the light.

This plant is distinct from any other species of the genus known to the author.

Distribution: Epiphytic on both surfaces of the fronds of *Gigartina lanceata* and, possibly, on other foliose species of the genus, occupying the spaces between the superficial lingulae, if present. Sublittoral along the shores of Stewart Island, the type locality. Common at midsummer.

Type specimen No. 8132, Herbarium Lindauer; iso-types distributed in Lindauer (1947), *Algae Nova-Zelandicae Exsiccatae,* Fasc. XI, No. 256.

Durvillea willana sp. nov.

Fig. 6

Frondibus 5 m. vel ultra longis, fuscis, coriaceis; disco scutato; stipite crasso, cylindrico, 1 m. longo, planius et latius crescente in latam complanatam laminam in segmenta loris similia plus minusve alte divisam; stipite ferente multas proliferationes irregulariter positas in omnibus longitudinis partibus, proliferationibus singulis efformatis e stipite, lamina, segmentis axem principarium simulantibus, interdum in margine positis in superiore complanata parte stipitis primarii.

Frond 5 m. or more long, dark brown, leathery, attachment a thick, scutate disc, stipe stout, cylindrical, 1 m. or more long, flattening and widening upwards into a broad complanate blade split more or less deeply into strap-like segments; stipe bearing many proliferations placed irregularly on all sides throughout its length, each consisting of a stalk, blade, and

segments similar to the main axis, proliferations sometimes becoming marginal on the upper, flattened portion of the stipe.

The plant somewhat resembles *Sarcophycus potatorum*, differing from it mainly in the presence of secondary branches, produced often in

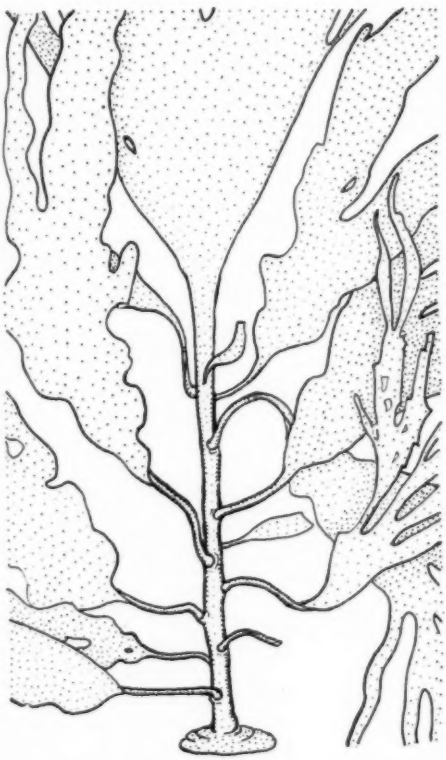

FIG. 6. *Durvillea willana* sp. nov.: habit sketch (× 0.08).

large numbers, sometimes 40 or more, from the main stipe. It differs from *Durvillea antarctica*, not only in its proliferated stipe, but in the absence of an internal layer of large, empty, colorless, columnar, polygonal chambers, which make the blade cushion-like to the feel, agreeing in that respect with *D. harveyi* of the Cape Horn region and *Sarcophycus potatorum* of Tasmania and Australia.

At low water, instead of sprawling on or hanging from the rocks, as is the habit of *D. antarctica*, the stipe of the new species stands erect with the blade drooping from its extremity. Hence the two species may readily be distinguished at a distance.

Distribution: Generally fringing rocks over a clean, sandy bottom in comparatively shallow water; missing where clean sand is absent; often growing with *D. antarctica* in suitable situations, but generally on the seaward side of it on a gently shelving bottom, and never with it over deep water. Common at Taylor's Mistake (Christchurch), Timaru, and south to Stewart Island; N. W. Nelson Province.

Named in honor of Mrs. Eileen Willa of Half Moon Bay, Stewart Island, whose tireless enthusiasm and intensive collecting have greatly assisted the author in his work.

Carpophyllum plumosum var. **quercifolium** var. nov.
Fig. 7*d–e*.

Frondibus erectis, ad 90 cm. altis, distichis; rachidibus complanatis, sinuosis, ramulis marginaliter et sat distanter etrudentibus, habitum speciei retinentibus; laminis basalibus querciformis, 5 cm. longis, cacuminibus obtusis, lobis obtusis; laminis medialibus arctioribus, lobis ornatis, acutis; laminis terminalibus simplicibus, parvis, infra attenuatis; vesiculis parvis, ellipsoidis, pedicellularibus; receptaculis paniculatis.

Frond erect, up to 90 cm. high, distichous, complanate, sinuous, the branches emerging marginally and somewhat distantly, in general habit resembling the original species; basal "leaves" oak-shaped, 5 cm. long with obtuse tips and blunt lobes; medial narrower, lobed, acute; terminal simple, small, attenuate below; vesicles small, ellipsoidal, pedicelled; receptacles panicled.

Distribution: In the sublittoral fringe at Chatham Islands, the type locality.

Type specimen No. 2480, Herbarium Lindauer.

Family RHODOPHYCEAE

Gigartina pachymenioides sp. nov.

Fig. 7*a–c.*

Frondibus erectis, fusco-rubris, complanatis, sub-cartilaginosis, ad 20 cm. altis; basi incrustata; stipite 1 cm. long, terete, paulatim patente in magis minusve certam "apophysim" ad 3 cm. longam, 1 cm. latam; lamina simplici, linearilanceolata vel flabellata, plurimis furcis diversis; basi laminae cuneata vel obtuso-rotundata ad 6 cm. lata; apicibus attenuatis; margine sinuoso, crenulato, subtiliter undulato vel minutis obtusis processibus ornato; superficie frondis tetrasporicae levi, e cystocarpio constante, sparse vel dense operta brevibus lingulis vel proliferationibus volutis simplicibus aut ramosis linearibus; cystocarpiis globosis, positis in marginalibus vel superficialibus papillis, ostiolatis, tetrasporangiis in soris in serie subcorticali sparsis, cruciatis.

Fronds erect, dark red, complanate, sub-cartilaginous up to 20 cm. high, base incrusting, stipe 1 cm. long, terete, widening gradually into a more or less distinct "apophysis" up to 3 cm. long and 1 cm. wide, blade simple, linear-lanceolate or flabellate and several times divergingly forked, base of blade cuneate or broadly rounded up to 6 cm. wide, apices attenuated, margins sinuous, crenulate, finely undulate or provided with minute, blunt outgrowths; surface of tetrasporic frond smooth, of the cystocarpic covered sparsely to densely with short lingulae or coiled simple or branched linear proliferations; cystocarps globose, borne on marginal or superficial papillae, ostiolate; tetrasporangia in scattered sori in the sub-cortical layer, cruciate.

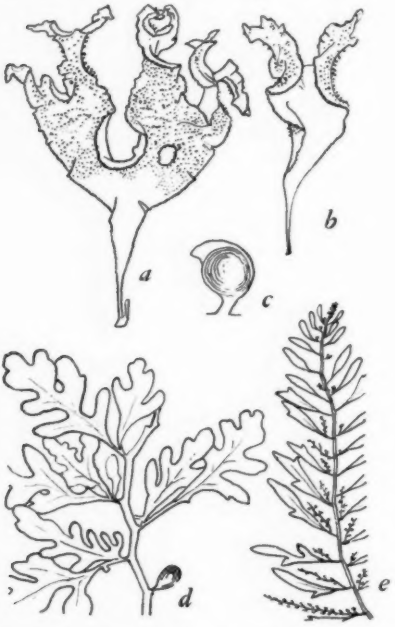

FIG. 7. Species of *Gigartina* and *Carpophyllum*. *a–c, Gigartina pachymenioides* sp. nov.: *a, b,* habit sketches (× 0.6); *c,* cystocarp (× 5). *d, e, Carpophyllum plumosum* var. *quercifolium* var. nov.: *d,* habit (× 0.6); *e,* fertile tip (× 0.6).

The form of the plant is very varied, the width and shape of the segments in particular being very irregular. There are no outgrowths from stipe or "apophysis," nor are papillae or reproductive organs present on apophysis or basal part of blade. The frond has a strong tendency to curl, so that the margins are wavy and the tips often spirally twisted. Unlike normal foliose *Gigartina,* it does not decompose quickly when exposed to rain in wrack along the shore, but remains firm and solid for a much longer period, in the manner of *Pachymenia;* hence its specific name.

No suggestions can be offered at the moment as to the probable affinities of this species in this most difficult genus. *G. pachymenioides,* beyond belonging to the foliose group of *Gigartina,* has very little in common with other local species.

Distribution: At and above low-water mark on cliff faces and rocks on Stewart Island, the type locality.

Type specimen No. 7403, Herbarium Lindauer; iso-types distributed in Lindauer (1948), *Algae Nova-Zelandicae Exsiccatae,* Fasc. XIII, No. 321.

Callithamnion levringii sp. nov.

Fig. 8*a–d.*

Fronde perdelicata, rosea, disticha, decompos-

ita, filimentosa, monosiphonia, ecorticata, ad 10 cm. alta, oriente e rhizoidibus basalibus; axe primario percurrente, flexuoso, in vicem sparse ramoso, ramis inferis longioribus, patentibus, laxis, ramulis alternis singulos ad articula singula ornatis, brevibus, fastigiatis, alterno-dichotomis; ramulis ultimis saepe secundis; articulis axis primarii 2 mm. longis, 0.3 mm. latis, ramulorum 6-cies longioribus quam latioribus, cacuminibus obtusis; cystocarpiis non observatis; sporangiis (?) obovoidis, breviter pedicillatis intra furculas ramulorum.

Frond very delicate, rose-red, distichous, decompound, filamentous, monosiphonous, ecorticate, up to 10 cm. high, arising from basal rhizoids; main axis percurrent, flexuous, sparsely alternately branched, branches longest below, patent, lax, clothed with alternate branchlets, one to each articulation, short, fastigiate, alternate-dichotomous, the ultimate ramuli often secund; articulations of main axis 2 mm. long, 0.3 mm. wide, of the ramuli 6 times as long as wide, tips obtuse; cystocarps not seen; sporangia (?) obovoid, shortly pedicillate within the forks of the ramuli.

The genus to which this plant belongs is questionable and may require revision when sexual plants are discovered. The form of the sporangium (?) is most unusual. It is first recognizable as such as the swollen and enlarged terminal cell of a lateral or axial 2-celled branch, the lower cell acting as a pedicel. At this stage it resembles a monosporangium. As it enlarges, the content is divided at the lower third, the upper larger part appearing to have been cut off from the lower part and resting in it. It now appears as an unequal bisporangium. Maturation progresses most rapidly at the distal end and soon the content is divided at the upper third. The sporangium (?) is now vaguely seirospore-like, but no further development has been observed.

In general vegetative habit the plant resembles *C. licomophorum* Harv., of Victoria, Australia, and is, perhaps, nearest to it, although

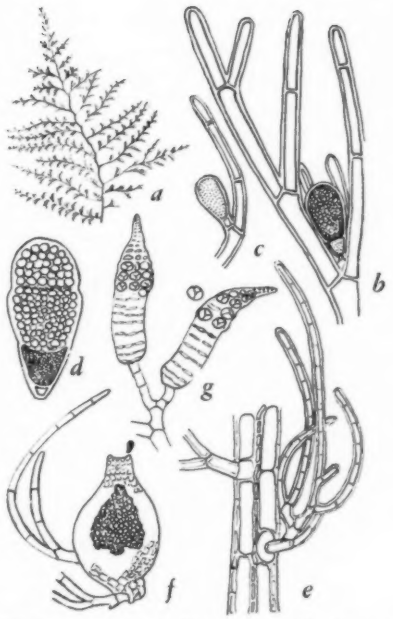

FIG. 8. Species of *Callithamnion* and *Dasya*. *a–d*, *Callithamnion levringii* sp. nov.: *a*, pinna (× 0.6); *b*, tip bearing polysporangium (× 65); *c*, young polysporangium (× 65); *d*, polysporangium almost mature (× 120). *e–g*, *Dasya subtilis* sp. nov.: *e*, portion of frond (× 120); *f*, cystocarp (× 120); *g*, tetra sporangial stichidia (× 120).

the New Zealand specimens lack rhizoids coating the main divisions and the reproductive bodies are dissimilar.

Distribution: So far found only in the drift at Pihama, Taranaki, the type locality. Summer.

Type specimen No. 7165, Herbarium Lindauer; iso-types distributed in Lindauer (1948), *Algae Nova-Zelandicae Exsiccatae*, Fasc. XIII, No. 325.

Dasya subtilis sp. nov.

Fig. 8*e–g*.

Frondibus parvis, rubescentibus, cristatis, teneris, flaccis, filiformis, 2–4 cm. altis, decompositis, in vicem subdistichose ramosis; ramis primariis corticatis, pericentricis cellulis 5; ramulis ultimis monosiphonis, dichotomis, divaricatis; articulis 3–4-cies longioribus quam latioribus, cacuminibus obtusis; ramulis terminalibus saepe aggregatis et involutis; cystocarpiis magnis, sessi-

libus in polysiphoniis basalibus segmentis lateralium, late ovoidis, ore conspicuo ornatis; tetrasporangiis positis in 2–3 regularibus seriebus in magnis fusiformis stichidiis in monosiphoniis pedicellis.

Fronds small, pink, tufted, tender and flaccid, filiform, 2–4 cm. high, decompound, alternately subdistichously branched, main branches corticate, pericentral cells 5, ultimate branchlets monosiphonous, dichotomous, divaricate, tips obtuse, articulations 3–4 times as long as wide, terminal ramuli often crowded together and incurled; cystocarps large, sessile on the polysiphonous basal segments of laterals, broadly ovoid with a prominent orifice; tetrasporangia in 2–3 regular rows in large, fusiform stichidia on monosiphonous pedicels. Summer; annual.

The plant is closely allied to *D. collabens* H. et H. but is very diminutive in size and is epiphytic upon a different type of host, as well as being restricted in range to the north of New Zealand. It is also able to withstand exposure to the atmosphere during low tides.

Distribution: On *Corallina* in the littoral region at low-water neap tide during the summer months; common at Long Beach, Russell (type locality); Auckland.

Type specimen No. 947, Herbarium Lindauer; iso-types distributed in Lindauer (1947), *Algae Nova-Zelandicae Exsiccatae,* Fasc. XII, No. 300, as *Heterosiphonia subtilis.*

ACKNOWLEDGMENTS

The writer is indebted to Professor V. J. Chapman of Auckland University College for many invaluable suggestions and continual help during the necessary research; to Professor G. F. Papenfuss of the University of California for much assistance in determining specimens and for consenting to read and criticize the original manuscript; to Mr. L. W. Crawley of Auckland University College for translating the descriptions into Latin; and to the Research Fund Committee of the University of New Zealand for the liberal grant made in connection with the writer's researches.

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NOTES

Notes on Three Beaked Whales from the Aleutian Islands

On June 6, 1947, in the company of a shore party from the motorship "Black Douglas," I discovered the putrid carcass of a male *Ziphius cavirostris* on the northeast side of Samalga Island, Aleutian Islands, Alaska. From this carcass, which was about 19 feet long, I recovered a portion of the right mandible, the symphisial region of both mandibles, and a portion of the mesorostral ossification. Dr. Remington Kellogg has kindly identified the remains and has placed them in the U. S. National Museum as Specimen No. 276,022 (original No. VBS 1371).

On November 12, 1947, I visited Amchitka Island, in the western Aleutians, and was told by Elmer C. Hanson that the body of a small whale had appeared on the beach near Constantine Harbor some months before. The waves pounded the body to pieces, but Mr. Hanson saved one tooth. In a letter of March 18, 1948, Dr. Remington Kellogg writes that "the large flattened tooth which is broken off above the base belonged to some species of *Mesoplodon*. It is not sufficiently complete for precise identification."

To the best of my knowledge, not over ten skulls or fragmentary specimens of *Berardius bairdii* Stejneger have been preserved. These have been collected around the rim of the north Pacific from Santa Cruz, California, and Tokyo Bay, Japan, on the south to the Pribilof and Commander Islands on the north. Through the kindness of Henry Swanson, I am able to add a recent specimen, the skull of a subadult of unknown sex, which is now in the U. S. National Museum, Biological Surveys Collection, Specimen No. 33431X (original No. BDM 294).

In the fall of 1948 Aleut natives saw the carcass of this specimen stranded on the beach about 5 miles from the village of Unalaska. I tried to recover it in November but could not land on account of a heavy surf. Mr. Swanson subsequently chopped off the head and sent it to Seattle, where it arrived on December 18, 1948.

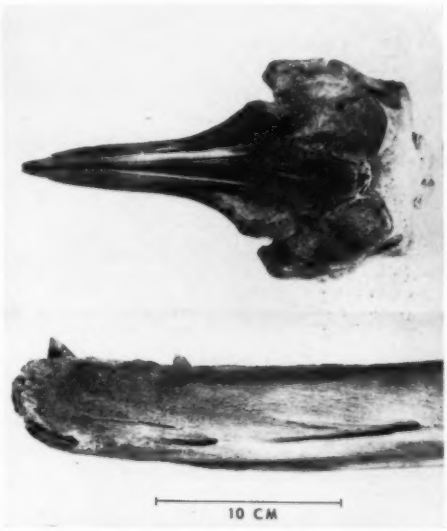

FIG. 1. Skull of Baird beaked whale from Unalaska, Alaska. Above, dorsal view; below, left mandible, anterior portion, outer face, showing the two teeth. (Scale applies to lower figure only.) (Photographs No. 2493 and 2495.)

Sea gulls, ravens, and foxes had torn at the flesh over a period of several months, with the result that the original contour of the head was lost. Karl W. Kenyon and I cleaned the skull in boiling dilute sodium hydroxide, and found that it measured 1,043 mm. in greatest length, and 537 mm. in greatest breadth (Fig. 1).

Berardius bairdii normally has four teeth, two in each half of the lower jaw. In my specimen the larger, foremost tooth of the pair is firmly rooted while the smaller, hindmost one can be easily picked out with the fingers.—*Victor B. Scheffer, U. S. Fish and Wildlife Service, Seattle, Washington.*

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News Notes

Seashore Treasures.—Dr. Charles H. Edmondson, Zoologist at the Bernice P. Bishop Museum, and Professor Emeritus of Zoology at the University of Hawaii, has combined his life-long interest in the reef and shore fauna of Pacific islands with the zeal of a scientist who has made of his work a hobby, and has written this book, and illustrated it, "for the younger scientists whose interest in things of the natural world, including seashore life, is beginning to develop." The several chapters, on reef fish and corals, on shells and slugs and squids, on crabs and sponges, and on many of those other forms of animal life found along so many Pacific shores, are written principally for the younger reader, but they will serve well to educate even the older reader in the facts of seashore life that may be new to him and to give him the answers to those many questions which even the youngest of visitors to the seashore, not yet old enough to read but already old enough to ask too many questions, will put to their elders when the family goes to the beach.

EDMONDSON, CHARLES H. Seashore Treasures. 144 pp., 200 figs. and photographs. Pacific Books, Palo Alto, California. Price $3.50.

The *Proceedings* of the South Pacific Commission's Third Session, held at Noumea, New Caledonia, from May 7 to 17, 1949, contains information of significance to scientists interested in certain of the economic and public health projects being directed by the Commission. Some of the research projects being contemplated or investigated are concerned with tuberculosis, filariasis, and other infectious diseases; nutritional and dietary problems; infant and maternal welfare; introduction of economic plants; tropical pasture improvement; hydrological and forest reserves; erosion control; fisheries research; and biological control of weeds and insect pests.

Proceedings. South Pacific Commission, Third Session. 3/Sec. 39/Rev. 1 and Pr. 8. 22 pp., with 3 appendices; mimeographed. Noumea, New Caledonia, 1949.

ERRATA IN VOLUME III, NO. 3 (JULY)

Page 241, Key III, line 3. *For* appically, *read* apically.

Page 249, legend for Fig. 5, line 3. *For* Cowan, *read* (Wawra) Hbd.

Page 270, line 1. *For* LANJOW, *read* LANJOUW.

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